U.S. Robotics®

COURIER™ HIGH SPEED MODEMS

COURIER HST™ dual standard with V.32 *bis* and ASL™

COURIER V.32 *bis* with ASL™

COURIER HST™ with ASL™

USER'S MANUAL

U.S. Robotics®

COURIER™ HIGH SPEED MODEMS

COURIER HST™ dual standard with V.32 *bis* and ASL™

COURIER V.32 *bis* with ASL™

COURIER HST™ with ASL™

USER'S MANUAL

©1988, 1990 by U.S. Robotics, Inc.
8100 North McCormick Blvd.
Skokie, IL 60076
All Rights Reserved

HOW TO USE THIS MANUAL

This manual contains operating instructions for Courier V.32 *bis*, Courier HST, and Courier HST Dual Standard modems. These modems have identical features except for the signaling they use to connect with remote modems at high speeds: V.32/V.32 *bis* or HST. Courier HST Dual Standard modems use either type of signaling, depending on the type of remote modem.

As you use the manual, keep the following guidelines in mind.

- The modem is shipped ready for most dial-up applications except for its flow control setting, which depends on the type of software and machine you're using. After you've set up the modem and tested its operation (Chapter 2) review the Quick-Start instructions in Chapter 3 for brief configuration guidelines.
- If you've purchased a Courier V.32 *bis* modem, disregard the instructions in this manual concerning HST operations. Conversely, if you've purchased a Courier HST modem, disregard the instructions concerning V.32/V.32 *bis* operations.
- All Courier high speed modems connect automatically with remote modems operating at 14.4K/12K/9600/7200/4800/2400/1200/300/110 bps, as long as the remote modems observe the standards listed under *Compatibility* in Chapter 1.

A NOTE ON COMMUNICATIONS SOFTWARE

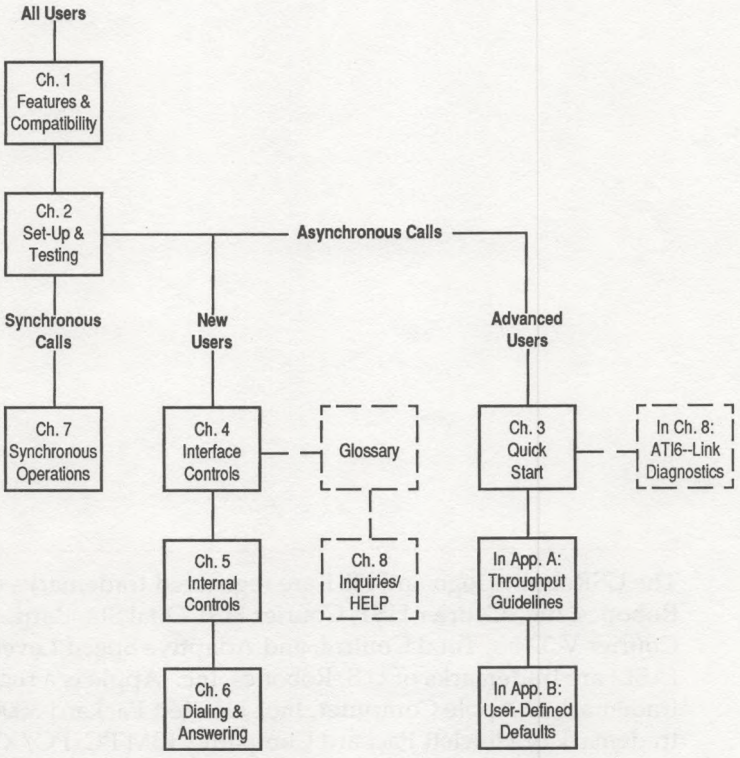
If you're using a computer rather than a terminal, you need communications software. Many brands are available, all of which are based on the modem's AT command set.

Some users prefer their communications software to take control of the modem, and are more comfortable with a program that makes the modem almost transparent. Others prefer a program that allows them to use the modem's AT command set sometimes, and their software at other times, depending on the task at hand. Whichever you prefer, review at least the Quick Start (Chapter 3) so that you have a basic understanding of the modem's requirements and operation.

USER PATHS

The paths shown in the diagram are suggestions only, designed for new and experienced users. Note that there is no separate path for HST-mode or V.32 *bis*-mode operation.

Most users will be making asynchronous calls. If you'll be making synchronous calls to a mainframe, you'll find all essential information in Chapter 7. However, you may find it helpful to review the more detailed operating instructions in other chapters as well.



Dashed lines indicate optional references. Additional points of reference:

Page		*Page*	
3-1	HST and V.32/V.32 *bis* Modes	B-12	S-Registers
B-4	Front Panel Indicators	E-2	Voice/Data Switch
B-9	Nonvolatile Memory—Storing Your Defaults Settings Supplement		Quick Reference Card

The USRobotics logo and HST are registered trademarks of U.S. Robotics, Inc. Courier HST, Courier HST Dual Standard, Courier V.32 *bis*, Total Control, and Adaptive Speed Leveling (ASL) are trademarks of U.S. Robotics, Inc. Apple is a registered trademark of Apple Computer, Inc. Hewlett Packard 3000 is a trademark of Hewlett Packard Company. IBM PC, PC/XT, PC/AT and Systems Network Architecture (SNA) are trademarks of International Business Machines Corp. Microcom Networking Protocol (MNP) is a trademark of Microcom, Inc. Touch-Tone is a trademark of American Telephone and Telegraph.

TABLE OF CONTENTS

How to Use this Manual ii
Table of Contents v
Limited Warranty x
FCC Registration Numbers xi
Connecting to the Telephone Company xi
DOC (Canada) xi
Radio and Television Interference xii
For Canadian Modem Users xiii

PART I. INSTALLATION AND OPERATION

CHAPTER 1—Features and Compatibility
Introduction 1-1
Compatibility 1-4

CHAPTER 2—Set-Up and Testing
Package Components 2-1
Operational Requirements 2-1
RS-232 Requirements 2-2
Front Panel Switches 2-3
Front Panel Indicators 2-4
Installing the Modem 2-4
Testing the Installation 2-7

CHAPTER 3—Quick Start: Asynchronous Calls
Asynchronous/Synchronous Communication 3-1
Initial Modem Settings 3-1
Recommended Settings 3-2
Alternative Settings 3-3
Data Format 3-4
Storing Defaults in Nonvolatile Memory 3-5
Dialing 3-5
Link Rate Negotiation 3-5
Online Fallback 3-6

CHAPTER 4—Interface Controls
Terminology 4-1
Changing Settings 4-2
High Speed Modulation: HST/V.32 *bis* 4-2
Modulation at 2400 bps and Below 4-3
Throughput Guidelines 4-3
Error Control 4-5

With Auto Answer 4-6
Flow Control Overview 4-6
Transmit Data Buffer Sizes 4-6
Received Data Buffer Size 4-6
Transmit Data Flow Control (&H*n*) 4-7
When it is Required 4-7
Hardware Control 4-7
Software Control 4-7
Guidelines 4-8
Received Data Flow Control 4-9
Hardware Control (R*n*) 4-9
Software Control (&I*n*) 4-9
Guidelines 4-11
Data Compression (&K*n*) 4-12
Data Rate Commands 4-13
Software Requirements 4-13
DTE Rate Select (&B*n*) 4-14
Link Rate Select (&N*n*) 4-15
Guidelines for Low Speed Calls 4-16
Data Set Ready (&S*n*) 4-16
Data Terminal Ready (&D*n*) 4-17
Carrier Detect (&C*n*) 4-17
Rack Controller Unit Access (%R*n*) 4-18
Touch-Tone Recognition (%T*n*) 4-18

CHAPTER 5—Internal Controls

Setting/Using Defaults 5-1
Writing Defaults to NVRAM (&W) 5-1
Loading the Factory Defaults (&F) 5-2
Reset (Z) 5-3
Storing Telephone Numbers (&Z*n=s*) 5-3
Result Codes 5-4
Response Modes (V*n*) 5-4
Quiet Mode (Q*n*) 5-5
Additional Result Code Subsets (&A*n*) 5-5
Result Code Sets (X*n*) 5-6
Local Echo 5-9
Command Mode Local Echo (E*n*) 5-9
Online Local Echo (F*n*) 5-9
The Audio Monitor 5-10
Speaker Control (M*n*) 5-10
Modem Clock Usage (K*n*) 5-11

Transmitter Enable/Disable (C*n*) 5-11
Break Handling (&Y*n*) 5-11
S-Registers 5-12

CHAPTER 6—Asynchronous Dialing and Answering
Before Connecting 6-1
Modulation/Standards 6-1
Setting the Transmission Rate 6-2
Data Format 6-2
Error Control 6-2
Placing Calls 6-3
Dial (D) 6-3
Cancel Dialing 6-3
Dialing Type, Pulse or Tone 6-4
Adaptive Dialing (X2-X7) 6-4
Pause (,) 6-4
Slash (/) 6-5
Wait for Another Dial Tone (W) 6-5
Dial and Return to Command Mode (;) 6-5
Dialing Letters (") 6-5
Transferring Calls (!) 6-6
Wait for an Answer (@) 6-6
Reversing Originate/Answer Frequencies (R) 6-7
Dialing a Stored Number (DS*n*) 6-7
Redialing 6-7
Dial the Last Dialed Number (DL) 6-8
Re-execute the Last Command (A/) 6-8
Automated Redialing (>, A>) 6-8
Continuous Repeat (>) 6-9
Continuous Re-Execute (A>) 6-9
Exiting Repeat Mode 6-9
Escape Code Operations (+++) 6-9
Modem Response to +++ 6-10
Returning Online (O) 6-11
Hanging Up (H*n*) 6-11
Automatic Answering 6-11
Suppressing Auto Answer 6-12
Points to Remember 6-12
International Calls 6-12
Handshaking Options (B*n*) 6-12
Guard Tone (&G*n*) 6-13
Pulse Dial Make/Break Ratio (&P*n*) 6-13

Chapter 7—Synchronous Operations
Overview 7-1
Data Rate Synchronization 7-1
Protocol Compatibility 7-1
Requirements 7-1
What You Need to Know 7-2
The RS-232 Interface 7-2
The Synchronous Adapter Card 7-2
Setting the Modem 7-3
Modulation/Link Rate Guidelines 7-3
Flow Control Guidelines 7-4
Transmit Clock Source (X*n*) 7-4
Synchronous Mode (&M1) 7-5
Dialing Out 7-5
Answering 7-5
Hanging Up 7-6
Additional Terminology 7-6

Chapter 8—Queries and Help Screens
User Inquiries (I*n*) 8-1
S-Register Query (S*r*?) 8-6
Phone Number Query (&Z*n*?) 8-6
Last-Dialed Number Inquiry (&ZL?) 8-6
Help Screens 8-6
Stop/Restart Display 8-6
Cancel Display 8-6
Basic Command Set ($) 8-7
Extended Command Set (&$) 8-7
Dialing (D$) 8-8
S-Register Functions (S$) 8-9

PART II. REFERENCE

Appendix A—Link Negotiation (Handshaking) and Error Control
Link Negotiation (Handshaking) A-1
HST Mode A-1
V.32 *bis* Mode A-3
Dual Standard Handshaking A-5
Error Control and Throughput A-5
CCITT V.42 Handshaking A-6
MNP Handshaking A-6
Data Compression A-6

Flow Control A-7
Throughput Guidelines A-7
Achievable Throughput A-9

Appendix B—Summaries and Tables
The RS-232 Interface B-2
Front Panel Indicators B-4
DIP Switch Summary B-6
Default Settings B-9
S-Register Summary B-12
ASCII Chart B-21

Appendix C—Alphabetical Command Summary
Basic Command Set C-1
Extended Command Set C-6
Percent Command Set C-11

Appendix D—Problems and Solutions D-1
If You Still Have Problems D-4

Appendix E—Additional Operations
Voice/Data E-2
High Speed/Low Speed Protocol E-5
Dedicated Line and Leased Line Operation E-8
Hewlett Packard 3000 Installations E-11
MI/MIC Operations E-12

Appendix F—Modem Testing
Testing with &T F-1
Ending a Test—&T0, S18 F-1
Analog Loopback—&T1, &T8 F-2
&T2 F-4
Digital Loopback—&T3 F-4
&T4, &T5 F-5
Remote Digital Loopback—&T6, &T7 F-5
Testing with Register S16 F-8
Analog Loopback—S16=1D F-8
Dial Test—S16=2 F-9
Test Pattern—S16=4 F-9
Remote Digital Loopback—S16=8 F-10

Appendix G—Glossary G-1

Appendix H—Technical Specifications H-1

Index

LIMITED WARRANTY

U.S. Robotics, Inc., warrants to the original consumer or other end user purchaser that this product is free from defects in materials or workmanship for a period of two years from the date of purchase. During the warranty period, and upon proof of purchase, the product will be repaired or replaced (with the same or similar model) at our option, without charge for either parts or labor. This warranty shall not apply if the product is modified, tampered with, misused, or subjected to abnormal working conditions.

REPAIR OR REPLACEMENT AS PROVIDED UNDER THIS WARRANTY IS THE EXCLUSIVE REMEDY OF THE PURCHASER. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE, AND U.S. ROBOTICS SHALL IN NO EVENT BE LIABLE TO PURCHASER FOR INDIRECT OR CONSEQUENTIAL DAMAGES OF ANY KIND OR CHARACTER.

Some states do not allow the exclusion or limitation of incidental or consequential damages or allow limitations on how long an implied warranty lasts, so the above limitations or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

To obtain service under this warranty, contact the U.S. Robotics Technical Support Department at 800/982-5151 or by mail at 8100 North McCormick Blvd., Skokie, Illinois, 60076-2920. You will be given a Return Materials Authorization (RMA) number to help us keep track of your warranty request. Once you have received your RMA number, take or mail the product, postage prepaid, to U.S. Robotics at the above address. Include proof of the date of purchase. IMPORTANT: If you ship your unit, pack it securely, be sure your RMA number is visible on the outside of the package, and ship it charges prepaid and insured.

Should you encounter problems in operating this device, follow the instructions in Appendix D in Part II of this manual. The Appendix contains solutions to operating problems as well as procedures to follow if there is an apparent modem malfunction.

FCC REGISTRATION

FCC68: CJE794-72748-MD-E

RINGER EQUIVALENCE: 0.4B

FCC15: CJE-0129

DOC (CANADA)

This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus set out in the radio interference regulations of the Canadian Department of Communications.

Le present appareil numerique n'emet pas de bruits radio-electriques depassant les limites applicables aux appareils numeriques de la classe B prescrites dans le Reglement sur le brouillage radioelectrique edicte par le ministere des Communications du Canada.

CONNECTING TO THE TELEPHONE COMPANY

It is not necessary to notify the telephone company before installing the modem. However, the telephone company may request the telephone number(s) to which the Courier is connected and the FCC information printed above.

If the telephone company has any questions or raises problems, ask them to call the Technical Support Department, USRobotics, Inc., 800/982-5151.

If the modem is malfunctioning, it may affect the telephone lines. In this case, disconnect the modem until the source of the difficulty is traced. Do not use the modem on party or coin telephone lines.

RADIO AND TELEVISION INTERFERENCE

This equipment generates and uses radio frequency energy and if not installed and used properly, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. Courier high speed modems have been tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Part 15 of FCC rules, which are designed to provide reasonable protection against such interference in a residential installation.

However, there is no guarantee that interference will not occur in a particular installation. If this device does cause interference to radio or television reception, which you can determine by monitoring reception when the modem is on and off, try to correct the problem with one or more of the following measures.

Reorient the receiving antenna.
Relocate the computer with respect to the receiver.
Relocate the computer and/or the receiver so that they are on separate branch circuits.

If necessary, consult your dealer or an experienced radio/television technician for additional suggestions. You may find the following booklet, prepared by the Federal Communications Commission, helpful:

How to Identify and Resolve Radio-TV Interference Problems
Stock No. 004-000-0345-4
U.S. Government Printing Office
Washington, DC 20402

In accordance with Part 15 of the FCC rules, any modification to or tampering with this device that causes harmful interference to others may be reason for prohibiting future operation.

FOR CANADIAN MODEM USERS

The Canadian Department of Communications (DOC) label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational, and safety requirements. The department does not guarantee the equipment will operate to a user's satisfaction.

Before installing this equipment, make sure you are permitted to connect it to the facilities of the local telecommunications company. You must also install the equipment using an acceptable method of connection. In some cases, you may also extend the company's inside wiring for single line individual service by means of a certified connector assembly (telephone extension cord). You should be aware, however, that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by a user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

For your own protection, make sure that the electrical ground connections of the power utility, telephone lines, and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

CAUTION: Do not attempt to make such connections yourself; contact the appropriate electric inspection authority or electrician.

Courier High Speed Modems Load Number: 41B

The Load Number (LN) assigned to each terminal device denotes the percentage of the total load to be connected to the telephone loop used by the device, without overloading. The termination on a loop may consist of any combination of devices, subject only to the requirement that the total of the Load Numbers of all the devices not exceed 100. An alphabetic suffix is also specified in the Load Number for the appropriate ringing type (A or B), if applicable. For example, LN = 41B designates a Load Number of 41 and a B-type ringer.

CHAPTER ONE. FEATURES AND COMPATIBILITY

INTRODUCTION

Congratulations! The Courier modem you've purchased represents powerful, advanced electronic design that offers exceptional reliability, compatibility and flexibility at all standard rates up to 14,400 bits per second (bps). The following features and capabilities assure you of superior reliability and performance.

High Speed Calls—Adaptive Speed Leveling (ASL)

All Courier high speed modems—HST, V.32 *bis* and Dual Standard—have a maximum connection rate of 14.4K bps. In addition, they monitor phone line quality and perform Adaptive Speed Leveling. Like most high speed modems, Courier modems fall back to the next lower speed (12K, 9600, 7200, 4800) if poor line conditions warrant. Unlike other modems, however, that stay at the lower rate for the rest of the call, Courier modems detect improved line conditions and shift upward again to the next higher speed. ASL keeps the modems online, always operating at the highest possible speed, and constantly ensuring data integrity.

Error Control—V.42/MNP

Data integrity is ensured when the modems connect with remote modems that use the V.42 (LAPM), USR-HST, or MNP error control protocols. Error control is available on calls at 1200 bps and above.

Data Compression—V.42 bis/MNP5

Data compression enables throughput of over 30K bps on 14.4K bps connections. Couriers connecting under V.42 error control use V.42 *bis* compression. Couriers connecting under MNP error control use MNP Level 5 compression. Achievable throughput of text and other types of files is listed in Appendix A.

Flow Control/Variable Interface Rates

Flow control, required under error control, also allows the local computer interface rate to be set higher than the link rate, enabling greater efficiency and throughput. Data can be sent from the computer to the modem at 38.4K or 19.2K bps, regardless of the link rate.

Trellis Coded Modulation

At speeds above 7200 bps the Courier uses trellis coded modulation. This technique makes high speed data transmission less vulnerable to errors caused by the phone network. The modems can tolerate twice the amount of noise in the telephone channel than they could with conventional modulation (quadrature amplitude modulation, or QAM), so there are fewer error control retransmissions. Trellis coded modulation is also less susceptible to impulse-type noise.

Asynchronous/Synchronous Capability

Courier high speed modems operate synchronously as well as asynchronously. A personal computer equipped with a synchronous interface adapter can call computers that use standard synchronous protocols. See Chapter 7 for more information.

Programmable Nonvolatile Memory

You can tailor your own default settings and store them in nonvolatile random access memory (NVRAM). Each time the Courier is powered on, it operates at the settings you've specified.

Link Rate Negotiation

The Courier automatically lowers its link rate to match a lower rate of a remote modem, in both Originate and Answer Modes, allowing connections with a wide range of installed modems.

Link Diagnostics

After each call, you can display a Link Diagnostics screen containing information about the last call, including the number of data characters transferred, line statistics, the call's rate and the reason the call was disconnected.

Voice/Data Switch

Users have always been able to phone and make arrangements with another user before turning control of the call over to the modems. A new feature, a switch on the modem's front panel, allows you to change from voice to data and back again, without issuing a command.

If you don't ordinarily use voice and data in the same call, you can assign the switch a different function that normally requires

a command, such as resetting the modem. See Appendix E, *Voice/Data*, for instructions on voice/data switching.

Modem Diagnostics

New CCITT V.54 loopback testing with the &T command options, and earlier Courier Register S16 test options are available. The modem performs three loopback tests: analog, digital, and remote digital. See Appendix F for information.

Inactivity Timer

You can set the modem to automatically hang up after a specified number of minutes if there is no activity on the phone line.

Call Duration Reporting

The modem records the duration of your calls in hours, minutes, and seconds. This feature enables you to display and print an audit of your calling activities. You can optionally use the modem clock as a real-time clock.

Call Progress Detection

An optional set of result codes (screen messages) lets you know when a line is busy, a person rather than a modem has answered the phone, there is no dial tone, or the distant phone is ringing.

Modem Settings Displays

On command, the modem displays its current settings, a handy way to check your transmission rate, S-Registers and other operational controls. The modem also displays the defaults stored in nonvolatile memory and the factory defaults stored permanently in read-only memory.

HELP Screens

The modem displays screens that summarize the command sets, Dial command options, and S-register functions.

Bottom Panel Reference

Command summaries and other information are printed on the bottom of the modem case. A Dual In-Line Package (DIP) switch guide makes it easy to tailor the switch settings to your terminal or software requirements.

Dialing the Last Dialed Number

The modem has a buffer that stores each dialed number until it is cleared by another Dial command. A few keystrokes cause the modem to redial the number in the buffer without your having to enter the number again.

Automated Redialing

You can put the modem into Repeat Mode to continuously redial if a previous dial attempt fails to connect. This is especially useful in dialing services whose lines are often busy.

Quote Mode

Set the modem to Quote Mode if you want it to dial an alphabetic acronym instead of a numeric number.

COMPATIBILITY

The Courier adheres to the following standards, ensuring compatibility with a wide base of installed modems. Unless otherwise indicated, HST, V.32 *bis* and Dual Standard modems all conform to the listed standard.

USR-HST	14.4K/12K/9600/7200/4800 bps (Dual Standard and HST modems)
CCITT V.32 *bis*	14.4K/12K/9600/7200/4800 bps (Dual Standard and V.32 *bis* modems)
CCITT V.32	9600/4800 bps (Dual Standard and V.32 *bis* modems)
V.22 *bis*	2400 bps
Bell 212A	1200 bps (also CCITT V.22)
CCITT V.23	1200 bps with 75 bps back channel (British phone system)
CCITT V.25	Answer sequence for calls originating outside the U.S. and Canada
Bell 103	300 bps (CCITT V.21 optional)

CCITT V.42	LAPM error control, 1200 bps and higher
CCITT V.42 *bis*	Data compression, 1200 bps and higher
MNP	Levels 2, 3 and 4 error control, level 5 data compression, 1200 bps and higher
CCITT V.54	Analog, digital and remote digital loopback testing

Other compatibility features include the following standards and certification:

- Can be used with any computer or terminal that is compatible with the RS-232 standard interface.
- Can be used with any computer or terminal that uses ASCII, the standard character code supported by most equipment manufacturers.
- Connects with older systems whose equipment operates at rates varying between 110 and 300 bps.
- Connects in synchronous mode at standard rates with any system using a synchronous protocol compatible with your synchronous interface equipment.
- Is fully FCC- and DOC-certified for the uses described in this manual.

CHAPTER 2. SET-UP AND TESTING

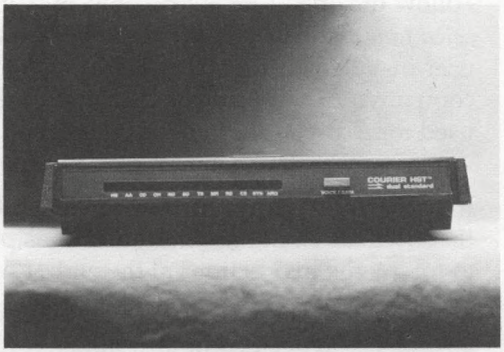


Figure 2.1—Courier Dual Standard, one of three Courier High Speed Desktop Modems

PACKAGE COMPONENTS

Your Courier modem package contains the following items in addition to this manual:

- The modem you purchased: Courier HST Dual Standard, Courier HST or Courier V.32 *bis*.
- An RJ11C phone cord.
- A power adapter.
- A Quick-Reference card, in this manual.
- A Settings Supplement, also in this manual. The supplement lists Courier DIP switch and other settings recommended for a number of popular communications software products.
- Your warranty card, to be filled out and returned to U.S. Robotics, Inc.

OPERATIONAL REQUIREMENTS

The Courier modem has minimal operational requirements. Be sure to read the information in the front of this manual about radio and television interference and connecting to the phone

company. In addition, you should be aware of the following conditions.

- Follow the operating instructions in Appendix E, *Dedicated Line and Leased Line Operation,* if your phone line is user-installed or if it is leased from the telephone company. Also referred to as *private,* these lines are used for a direct, continuous connection between two modems. The connection is made without dialing.
- If your modem is installed in a Hewlett Packard system that uses the *Ack/Enq* communications protocol, be sure to follow the instructions at the end of Appendix E.
- If the modem is attached to a computer instead of a terminal, you need communications software. The software uses the modem's AT command set to control many communications functions, including configuring the modem, dialing, and answering calls, and also enables the transfer of files and other operations.

  Some users prefer their communications software to take control of the modem, and are more comfortable with a program that makes the modem almost transparent. Others prefer a program that allows them to use the modem's AT command set sometimes, and their software at other times, depending on the task at hand. Whichever you prefer, review at least the Quick Start (Chapter 3) so that you have a basic understanding of the modem's requirements and operation.

RS-232 Requirements

You'll need an RS-232 cable to connect the modem to your computer or terminal. *Use a shielded cable* to ensure minimal interference with radio and television reception.

The modem takes a DB-25P (25-pin plug, or male) connector at one end of the cable. Computer equipment varies, however. Check the serial port at the rear of your machine, which may be labeled SERIAL, COMM PORT, or some other term (e.g., RS-232). If there are no labels, review your machine documentation to find out which is the serial port. (There may be more than one.) Don't use a port marked PARALLEL, PRINTER or AUX.

The physical serial port on the computer or terminal will be either a socket (female) or plug (male) that typically accommodates 25 or 9 pins. For example, the port on the IBM PC, XT and most compatibles requires a DB-25S (socket) connector, while the port on the IBM AT and some compatibles requires a DB-9S connector. Apple computers require a DB-25P, DB-9P or, more typically, an 8-pin round plug connector. Check your computer documentation or with your computer dealer.

NOTE: Appendix B includes a listing of RS-232 pin assignments required to operate the modem. Be sure to check the appendix if you're not sure what type of cable you need, or if you're building your own. If your machine has other than a 25- or 9-pin port, check your computer documentation or consult your dealer to find out what type of RS-232 connector is required.

WARNING: If you're planning to use the fastest computer-to-modem rate of 38.4K bps, follow the instructions concerning the RS-232 cable in Appendix B. The guidelines there will help you to avoid signal degradation at the 38.4K rate.

FRONT PANEL SWITCHES

Voice/Data

This pushbutton switch is used primarily to switch between voice and data communications during a call. Detailed instructions are in Appendix E, *Voice/Data Calls*. The switch has multiple functions, however. Options are as follows:

Disable the switch
Force the modem off hook in Originate mode (default)

Force the modem off hook in Answer mode

Have the modem redial the last dialed number

Have the modem dial the first number you've stored in nonvolatile memory

Toggle Auto Answer on and off

Reset the modem to its defaults

Initiate Remote Digital Loopback testing

Volume Control

This is a rotary switch under the front panel, near the right corner. Turning it clockwise increases the volume of the

modem's speaker. Turning it counter-clockwise decreases the volume.

FRONT PANEL INDICATORS

Below is a list of the modem's twelve status lights, or LEDs. See Appendix B for descriptions of their operations.

HS	High Speed	TR	Data Terminal Ready
AA	Auto Answer	MR	Modem Ready (Power)
CD	Carrier Detect	RS	Request to Send
OH	Off Hook	CS	Clear to Send
RD	Received Data	SYN	Synchronous
SD	Send Data	ARQ	Automatic Repeat Request (Error Control)

INSTALLING THE MODEM

1. Turn off the computer or terminal and its peripheral devices.
2. Examine the label on the bottom of the modem. In addition to the summaries and other information, the label contains icons to aid in modem assembly. Check the interfaces at the back of the modem, shown in the following photograph.

Figure 2.2—Interface End, Courier Modem

3. Now review the attached interfaces in Figure 2.3.

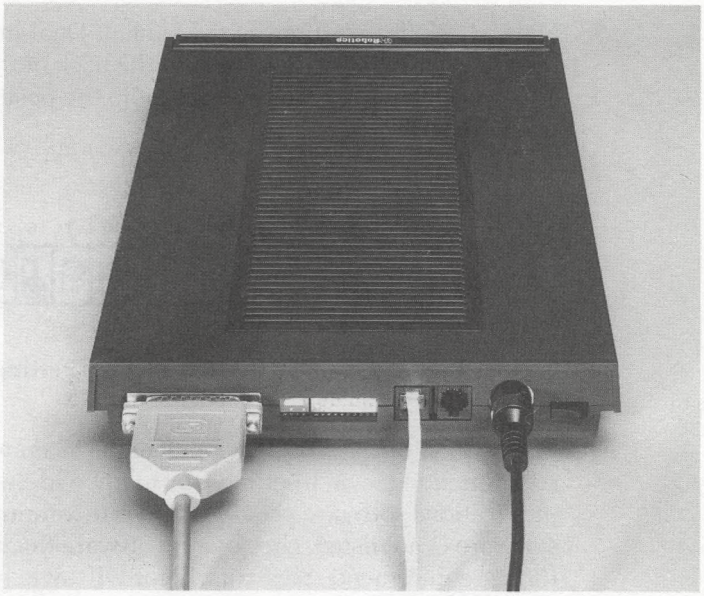


Figure 2.3—Connected Courier Modem

4. Check to make sure that the power switch is OFF; press it towards the zero in the 1/0 icon on the bottom label. Plug the power supply adapter's small connector into the power jack at the back of the modem. Plug the adapter into a standard 115-volt AC wall socket.

   Disconnect your present phone cable from the wall jack. Plug one end of the phone cable that came with the modem into the modem's phone jack that is near the wall-jack icon on the bottom label. Plug the other end into the wall jack.

   NOTE: Older telephone installations may not have the appropriate modular wall jack and plug. Adapters and RJ11C connectors are available from your telephone company or computer dealer.

   If you want to keep your telephone connected for conventional calls, plug its cord into the jack at the rear of the modem near the phone icon. You can also use both your

telephone and modem in one call, although not at the same time. *Voice/Data*, in Appendix E, explains how to switch control of the phone line between the phone and the modem.

5. Next, check the positions of the bank of Dual In-Line Package (DIP) Switches located at the back of the modem. These switches are set at the factory to the positions most users require.

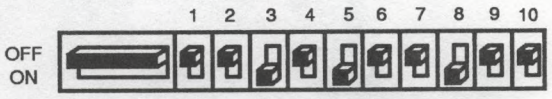


Figure 2.4—DIP Switch Factory Settings

The *Settings Supplement* that came with the manual shows recommended switch settings for many widely-used communications software products. If your communications software is not listed, check your software documentation for its requirements, particularly for DIP switches 1, 4, 5 and 6. You'll also find descriptions of switch functions and options in Appendix B.

If you already know your requirements, use the guide on the bottom of the modem or the summary in the Quick Reference Card to verify the switch positions.

NOTE: If you have built your own RS-232 cable and it does not support Data Terminal Ready (DTR), set DIP switch 1 DOWN, for the DTR override. The override causes the modem to operate as if the DTR signal is always ON, and enables the modem to accept commands. Most purchased communications software, however, requires DTR.

DIP switch 10 is explained under *Setting/Using Defaults* in Chapter 5. Most users will want to leave this switch OFF, write their own defaults to nonvolatile memory (NVRAM), and have those defaults loaded at power on.

The wider *Quad* switch on the left of the numbered switches should be left UP *unless you know your equipment reverses the*

transmit and receive pins at the RS-232 interface (see Appendix B, DIP Switch Summary).

6. The final step is to connect the modem to the computer's or terminal's serial port with the RS-232 cable described earlier in this chapter. Attach the appropriate connectors to the modem and to the serial port.

NOTE: To prevent overheating, do not cover the vents on the top of the modem case.

The modem is now ready to be tested and operated.

TESTING THE INSTALLATION

Use the following procedures to verify that your modem is working properly.

1. Turn on your computer or terminal and clear the screen. Then turn the Courier's power switch ON. The following front panel indicators, or LEDs, will light up.

   CD Carrier Detect, if you have set DIP switch 6 DOWN, enabling the CD override

   MR Modem Ready/Power ON

   CS Clear to Send

   TR Data Terminal Ready, if you have set DIP switch 1 DOWN, enabling the DTR override

   For more information on the front panel indicators, see Appendix B.

2. If you're using a personal computer, load your communications software. If your software allows, perform the function that lets you send AT commands to the modem, that is, puts the computer in *Terminal Mode*. Some communications programs do this automatically upon loading. Others require you to display a communications or terminal screen, type a Function key, or perform some other operation.

   If necessary, refer to your communications software documentation for instructions.

If necessary, refer to your communications software documentation for instructions.

3. Set your terminal or software to 19.2K bps or 9600 bps. In addition, set a word length of either 7 bits plus 1 parity bit, or 8 bits with no parity—it doesn't matter which now—and 1 Stop bit.

4. Check to see if your computer or terminal and modem are communicating with each other by sending the following *attention* command. Type either upper or lower case letters, not a combination, and then press the Enter (Carriage Return) key, shown in the example below between angle brackets. (Don't type the angle brackets.)

   AT <Enter>

   If everything is correct, the modem responds as follows:

   OK

   NOTE: The modem is shipped with DIP switch 4 UP, causing the modem to display (echo) your keyboard commands. If your entered command is not displayed, your local echo is OFF. To turn the local echo ON, send the modem the following command.

   ATE1 <Enter>

   If double characters appear on the screen, both your modem and software are set to local echo ON. Either set your software to local echo OFF, or turn the modem's echo OFF with the following command.

   ATE0 <Enter>

Troubleshooting

If no OK appears on your screen, review the following checkpoints.

a. Make sure you type all upper or lower case letters and press <Enter>.

b. Check to see that you set your communications software to the correct serial port.

c. Make sure your software has put the computer in Terminal mode, so that you can send the modem commands. Then review Step 4, above.

d. Be sure that DIP switches 1 and 6 are set ON or OFF according to your terminal or software requirements. Review the table in Appendix B as well as your terminal or communications software documentation.

e. Both the Quad switch on the left and DIP switch 10 should be in the UP position.

f. If you set DIP switch 8 UP, for Dumb mode, reset the modem to Smart mode: set DIP switch 8 DOWN, power off the modem, and power it on again.

g. DIP switch 3 controls the display of the modem's result codes, including the OK result. The modem is shipped with DIP switch 3 DOWN, enabling the result codes. If DIP switch 3 is UP, reset it to the DOWN position. Then initiate the new switch setting with the following reset command.

ATZ <Enter>

5. A final check of the modem is to see that it gets a dial tone. Type the following *manual Dial* command:

ATD <Enter>

On receipt of the command, the modem goes off hook and waits for a dial tone. The OH indicator lights, and you'll hear the dial tone from the modem's speaker. If you don't hear the dial tone, increase the volume by turning the volume control switch higher (clockwise). To cancel the operation, press any key.

If you don't hear a dial tone, check to see that the phone cable from the wall jack is connected to the jack identified by the wall jack icon on the bottom label of the modem case. If necessary, reconnect the phone cable correctly to jack near the wall jack icon, and try the ATD command again. Then try the manual Dial command again, ATD <Enter>.

CHAPTER 3. QUICK START—ASYNCHRONOUS OPERATIONS

ASYNCHRONOUS/SYNCHRONOUS COMMUNICATIONS

Courier high speed desktop and rack modems are capable of asynchronous and synchronous communications. Terminals are usually capable of one type of communications or the other. The typical personal computer, however, is equipped to communicate only asynchronously.

Most of the operational information in this manual is organized around asynchronous communications. During asynchronous communications, the computer adds Start and Stop bits to each data character before sending it to the modem over the serial port, and expects received data to be in the same format.

Synchronous data transfer is based on synchronized timing between two communicating devices, not on data format, and is usually required by mainframes and other large computers. To exchange data synchronously, a personal computer requires specialized equipment, including the installation of a synchronous communications card with a synchronous port. If you will be making synchronous connections, you'll find the modem easy to use. Just follow the instructions in Chapter 7.

INITIAL MODEM SETTINGS

This manual covers the operation of three Courier models, the Courier HST Dual Standard, Courier V.32 *bis*, and Courier HST. The modems are factory-set for compatibility with their own type of modem.

- Dual Standard modems—B0—so that they connect at high speeds with both V.32 bis and HST modems
- V.32 *bis* modems—B0—to connect at high speeds with V.32 *bis* and V.32 modems
- HST modems—B1—to connect at high speeds with HST modems

The above settings do not affect how the modems connect at speeds of 2400 bps and below. Leave the modems set to their factory defaults, B0 or B1. The exception is when an HST modem is to answer overseas calls, in which case you should set it to B0.

The modem is shipped ready for use except for ***Transmit Data flow control***. This type of flow control is required for calls under error control, and when the computer sends data to the modem faster than the modem can send it over the phone link.

How you set your modem depends on whether or not your machine or software support flow control, and what type of flow control they allow. Use the guidelines that follow.

Recommended Settings

The following modem settings, plus the factory defaults, are recommended for data reliability and for the best throughput. Check the *Settings Supplement* that came with the modem to see if your communications program is listed and what it supports. Check your computer or terminal documentation as well to see if your machine supports the recommended settings. If not, see *Alternative Settings*, after this section.

Modem Setting	Result
&H1	Hardware flow control: the modem uses Clear to Send (CTS) at the RS-232 interface to control the data flow from the computer. This is the more reliable type of flow control.
&B1	The data rate between the modem and the computer (Data Terminal Equipment, or DTE) is fixed; it does not switch to match the phone link rate when the modem connects with a remote modem.

Software Setting	Result
19.2K bps Fixed rate	The rate between the modem and the computer (DTE) is always 38.4K or 19.2K bps. This allows calls at the maximum speed of 14.4K bps on the phone line. The 38.4K rate provides the greatest efficiency when a call is under error control and data compression.

NOTE: If you use an IBM PC or compatible ***and*** your software supports the above settings, we recommend that you write them to nonvolatile memory with the &W command as defaults. If

one of these conditions isn't true, review the following alternatives and guidelines.

Alternative Settings

1. Your machine or software doesn't support Clear to Send, but your software supports XON/XOFF signaling:

   &H2 The modem sends the DTE Ctrl-S and Ctrl-Q (XOFF/XON) characters to control the flow of data. But see Guideline #2 below.

   &B1 As above, under Recommended Settings, providing your software supports a fixed DTE rate.

2. Your machine or your software does not support Clear to Send, and you're using an Xmodem-type file transfer protocol:

   &H0 Flow control disabled (factory setting). Do not use software flow control (&H2) because the protocol control characters will be misinterpreted as flow control characters, and you risk losing data.

   &B0 The DTE rate switches to match the connection rate of each call. Required because there is no flow control.

   NOTE: We do not recommend the use of Ymodem-G or Zmodem without the use of error control and flow control.

3. Your system doesn't support either Clear to Send or XON/XOFF signaling:

   &H0 Flow control disabled (factory setting).

   &B0 The DTE rate switches to match the connection rate of each call. Required because there is no flow control.

   &M0 Error control disabled; recommended because there is no flow control.

   NOTE: We recommend that this configuration not be used for calls above 2400 bps.

4. Your software does not support a fixed rate:

   &B0 Factory setting. The DTE rate switches to match the connection rate of each call. This does not affect error control or flow control. You will not, however, gain the throughput efficiency possible when the DTE rate can be fixed at a higher rate than the link rate. In addition, at the factory setting for data compression, &K1, the modem disables compression when the link rate is set to &B0.

5. Your maximum computer rate is 9600 bps:

   S34=3 This disables higher-speed V.32 *bis* modulation. The modem operates as a V.32 modem, with a maximum DTE and link rate of 9600 bps. (Does not apply to HST modems.)

   &H1 Hardware flow control (CTS), or &H2 for software flow control.

   &B1 Fixed DTE rate of 9600 bps, recommended for HST modems.

   &M4 Error control factory setting required, or &M5.

6. You are calling a non-MNP modem:

   S27=16 Disable MNP handshaking. A non-MNP modem may misinterpret the MNP link request and prevent a successful connection. This does not apply for remote V.42 modems with error control enabled.

7. You are transferring compressed files:

   &K3 This disables MNP compression, which does not work successfully with files that are already compressed. If V.42 *bis* compression is negotiated, you will gain optimal throughput.

DATA FORMAT

The Courier and the remote modem must use the same ten-bit data format. The following table lists the allowable word lengths, parity and Stop bits. If a remote modem requires 2 Stop

bits and the format totals 11 bits, the second Stop bit is not counted.

Start Bits	Word Length	Parity (1 Bit)	Stop Bits
1	7	Even, Odd Mark, Space	1
1	7	None, Even, Odd, Mark, Space	2
1	8	None	1, 2

STORING DEFAULTS IN NONVOLATILE MEMORY

Write your default configuration to nonvolatile memory (NVRAM) with the &W command. The following example sets the modem for the current session and also stores the settings as defaults. The defaults are loaded from NVRAM when the modem is powered on if DIP switch 10 is UP.

Be sure to insert &W last in the string, before the Carriage Return.

AT &B1 &H1 &W <Enter>

DIALING

Use the following command format. The modem defaults to pulse dialing: the T in the command enforces tone dialing. The maximum number of characters in a command string is 40.

ATDT *phonenumber* **<Enter>**

To redial the number, which the modem stores in a last-dialed number buffer, use the following command:

ATDL <Enter>

LINK RATE NEGOTIATION

During link negotiation (handshaking), the modems negotiate the highest possible rate, depending on each modem's capabilities. The Courier automatically switches rates to match the rate of the remote modem, within the following rate ranges: 14.4K, 12K, 9600, 7200, 4800, 2400, 1200 bps and, without error control, 300 bps. For more detailed information on handshaking, see Appendix A.

ONLINE FALLBACK

When online at high speeds, the modems perform Adaptive Speed Leveling. They monitor the condition of the phone line. If they sense disturbances that threaten data integrity, they fall back and retrain (resynchronize) at the next lower speed in their fallback range: 14.4K, 12K, 9600, 7200, 4800 bps.

If conditions remain poor, Courier modems continue to fall back to the next lower speed. As line improvements occur, they fall forward to the next higher speed, up to the link rate of the call.

CHAPTER 4. INTERFACE CONTROLS—ASYNCHRONOUS OPERATIONS

Use the commands explained in this chapter to select modem settings at the terminal or computer and phone link interfaces. These settings apply only to asynchronous operations. For synchronous calls, see Chapter 7.

TERMINOLOGY

ARQ (automatic repeat request, or retransmission) is the term used by USRobotics in error control commands and response codes. An ARQ connection indicates a call under error control.

The terminal or computer is referred to as the *DTE* (Data Terminal Equipment). The DTE rate is the rate at which your DTE and Courier modem communicate, for example, 19.2K bps. The Courier modem is referred to as the *DCE* (Data Communications Equipment).

Figure 4.1 indicates which commands control modem operations at the DTE/DCE (computer-to-modem) and phone link (modem-to-modem) interfaces.

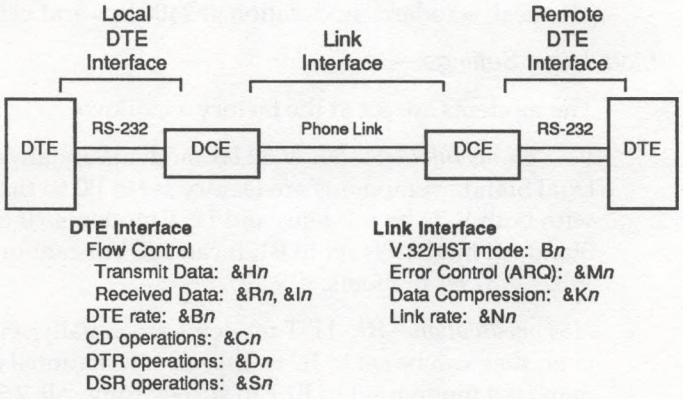


Figure 4.1—Interface Control Commands

Detailed command descriptions are in this chapter. If you're familiar with modem operations, you may want to review the Quick-Start instructions in Chapter 3 instead.

CHANGING SETTINGS

When you change a setting, the modem retains it until you do one of the following:

- Change the setting.
- Issue the ATZ command to reset the modem. If DIP switch 10 is UP, the modem resets to the defaults stored in nonvolatile memory (NVRAM). If DIP switch 10 is DOWN, the modem resets to the factory settings stored in read-only memory (ROM).
- Issue the AT&F command to reset the modem to its factory settings.
- Turn the modem off, and power it on again. The modem then loads either the nonvolatile memory defaults (DIP switch 10 UP) or the factory settings (DIP switch 10 DOWN).

HIGH SPEED MODULATION: V.32 BIS/HST

At high speeds, USRobotics modems use either V.32 *bis* modulation or HST modulation, unless they are Dual Standard modems that have both capabilities. By high speeds we mean calls at 14.4K, 12K, 9600, 7200 or 4800 bps. (The modems use identical, standard modulation at 2400 bps and below.)

Modulation Settings—Bn

The modems are set at the factory as follows:

V.32 bis modulation—B0. V.32 *bis* modems are always set to B0. Dual Standard modems are factory set to B0 so that they connect with both V.32 *bis* modems and HST modems. If a Dual Standard modem is set to B1, it can call but cannot answer V.32/V.32 *bis* modems.

HST modulation—B1. HST modems are usually set to B1. However, they can be set to B0 to answer international calls. A Dual Standard modem set to B1 can successfully call V.32/V.32 *bis* or HST modems but, as mentioned above, cannot answer V.32/V.32 *bis* calls.

Under V.32 *bis* modulation, data flows at the same rate in both directions. Under HST modulation, data flow is asymmetrical: the high speed in one direction and 450 bps in the other. The

modems switch the fast and slow channels when the volume of data flow changes. Interactive applications appear faster under V.32 modulation, while connection times are faster under HST modulation.

WARNING: To connect at 14.4K bps, the DTE rate must be 19.2K or 38.4K bps. If the local computer is limited to 9600 bps, the modem must operate as a V.32, not a V.32 *bis* modem. Disable V.32 *bis* modulation so that the modem does not switch its DTE rate up higher than 9600 bps. Do this by setting Register S34 to 3 (S34=3) and including that setting in the defaults you write to nonvolatile memory, as shown in the next chapter.

MODULATION AT 2400 BPS AND BELOW

The B*n* setting is not significant at speeds of 2400 bps and lower except for answering calls from overseas. (See *International Calls* at the end of Chapter 6.) The only difference you might notice is that the B1 setting (Bell answer tone) allows the modems to connect slightly faster. Error control, DTE rates, flow control and other settings are the same for both HST and V.32 *bis* modems.

THROUGHPUT GUIDELINES

The following guidelines should help you to make the most of your modem's advanced performance features. In many instances, experimentation and experience will indicate what works best for your applications.

You'll obtain optimal throughput under the following conditions.

1. Your communications software supports a fixed DTE rate higher than the link rate, for example, setting your software to 38.4K or 19.2K bps and setting the modem to &B1. Check the *Settings Supplement* that came with the modem or your software manual, and see *Data Rate Commands* in this chapter.
2. The call is under data compression. See *Data Compression (&Kn)* in this chapter.

3. You're transmitting text files. Throughput is higher for text files than for other types of files, such as .EXE or .COM binary files. For a comparative table, see the end of Appendix A.

4. File transfer is not slowed down by a file-transfer protocol. Many non-text files require a file transfer protocol, but throughput result vary. Certain public domain file transfer protocols, for example, have the following effects:

   Kermit — Throughput is severely reduced due to Kermit's short block lengths (under 128 bytes) and acknowledgment turn-around time.

   Xmodem — Throughput may be reduced if your version uses short block lengths, for example 128 bytes. Some versions use blocks of 1K bytes, which is much better, although overhead (error control protocol information) still affects overall throughput.

   Ymodem — This protocol is better than some because of larger block lengths (1K bytes), although overhead (error control protocol information) still affects overall throughput.

   The above protocols further reduce throughput during error control (ARQ) connections. The accuracy of the data is checked twice, by the file transfer protocol and the modem. To avoid redundancy, use the above protocols only for non-ARQ connections, and only at speeds of 2400 bps and lower.

   For the best throughput on ARQ connections, at high speeds and at 2400 bps, we recommend **Zmodem** or, for even better efficiency, **Ymodem-G**. These protocols assume the modems are handling error control: overhead is minimal, with throughput almost equal to that obtained with no file transfer protocol.

   WARNING: If you are using an X, Y or Zmodem-type protocol, do not use the modem's software flow control. See the more detailed warnings in this chapter under Transmit Data Flow Control (&Hn) and Received Data Software Flow Control (&In).

ERROR CONTROL (&Mn)

The Courier first attempts a connection using V.42 (LAPM) error control and, if that doesn't succeed, it attempts an MNP connection. If that doesn't succeed, the Courier tries to connect without error control. (The process takes much less time than it takes to key in this paragraph.)

The exception to the above is that HST modems, at high speeds, do not use V.42 error control. They use USRobotics' proprietary HST technique, an MNP-type of protocol adapted for its high speed/low speed asymmetrical modulation.

Error control is possible at speeds of 1200 bps and higher. For more detailed information, see Appendix A. The following options are available.

&M0 Normal mode, no error control. Because of the nature of phone line channels, this is never recommended for calls above 2400 bps.

&M1 This setting is exclusive of the modems' error control and is used only for Synchronous mode. See Chapter 7, *Synchronous Operations*, for instructions.

&M2 Reserved.

&M3 Reserved.

&M4 Normal/ARQ mode. This setting is the default. If the remote modem doesn't recognize the Courier's error control signals—V.42, HST or MNP—the modem operates in Normal mode, as though it were set to &M0.

NOTE: V.32 *bis* modems reverting to Normal mode transfer data at high speeds without the reliability of error control. To avoid this, V.32 *bis* and V.32 modems, local and remote, should always be set for error control. HST modems, if unable to establish an error control connection, drop to 2400 bps.

&M5 ARQ mode. If the remote modem doesn't recognize the error-control request—V.42, HST or MNP—the Courier hangs up.

With Auto Answer

When set to &M4 or &M5 and a call comes in, the modem goes off hook and responds to received error control signals. If the modem doesn't receive those signals and is set to Normal/ARQ mode (&M4), it answers the call in Normal mode (&M0). If it doesn't receive the signals and is set to ARQ mode (&M5), it hangs up.

FLOW CONTROL OVERVIEW

This feature controls the flow of data into and out of the modem's Transmit and Receive data buffers. Due to variations in computer and terminal equipment and in software requirements, the Courier is shipped with all flow control options disabled.

Users at Hewlett Packard installations that use the ENQ/ACK protocol should note the HP settings, &I3 and &I4, described under *Received Data Software Control (&In)*.

NOTE: Flow control of data from the DTE to the modem is required under the circumstances described under *Transmit Data Flow Control (&Hn)*. Received Data flow control is not as critical unless, for example, you are writing incoming files to disk on a very slow computer.

Transmit Data Buffer Sizes

The size of the Transmit data buffer depends on whether the connection is under error control or not, as follows.

- ARQ connections: 3.25K bytes.
- Non-ARQ connections: 1.5K bytes, allowing use of error control file transfer protocols such as Xmodem and Ymodem without flow control.

If bit 3 of Register S15 is turned on, the non-ARQ buffer size is reduced to 128 bytes, for the convenience of some remote users of slower modems. See *S-Register Summary*, S15, in Appendix B.

Received Data Buffer Size

The size of this buffer remains constant at 2K bytes.

TRANSMIT DATA FLOW CONTROL (&Hn)

This type of flow control is for data transmitted to the modem by its attached DTE, that is, by your computer or terminal. The modem monitors its buffer as data comes from the DTE. If the buffer approaches 90% capacity, the modem signals the DTE to stop transmitting. When the modem has sent enough data over the link to half empty the buffer, it signals the DTE to resume transmitting.

When it is Required

Transmit Data flow control should be enabled in the following situations.

- You're using error control (any allowable speed above 300 bps), with or without data compression.
- The DTE rate is higher than the link rate, for example, the DTE is sending data to the modem at 38.4K or 19.2K bps and the link rate is 14.4K bps. Another example is a DTE rate of 19.2K bps and a link rate of 2400 bps.

NOTE: The modem uses either hardware or software flow control. Your software and machine must support whichever type you select, although we recommend hardware flow control, if possible. Review the *Settings Supplement* that came with the modem and, if necessary, your software and computer manuals.

Hardware Control

The modem drops the Clear to Send (CTS) signal it's been sending to the DTE when the modem's buffer nears 90% capacity. It starts sending CTS again when the buffer is about half full.

Software Control

The modem sends the DTE the standard ASCII Transmit OFF (XOFF) character, <CTRL-S>, when its buffer nears 90% capacity. The modem sends the ASCII Transmit ON character, <Ctrl>-Q, when the buffer is about half full. ASCII definitions are as follows:

XON	<Ctrl>-Q	(ASCII 17 Decimal, 11 Hex)
XOFF	<Ctrl>-S	(ASCII 19 Decimal, 13 Hex)

NOTE: You may have to set your software as well to either hardware or software flow control. Some programs also require that you turn off the type you are not using.

&H0 Transmit Data flow control disabled. Default.

&H1 Hardware flow control. Recommended setting. Requires that your DTE and software support Clear to Send (CTS) at the RS-232 interface.

&H2 Software flow control. Requires that your software support XON/XOFF signaling. See the guidelines that follow. The ASCII characters may be user-defined. See Registers S22 and S23 in Appendix B. That appendix also includes an ASCCI chart.

&H3 Use both hardware and software flow control. If you are unsure about what your equipment supports, select this option. But keep the warning, above, in mind about software flow control.

WARNING: If possible, always use hardware flow control. You may lose data if XON/XOFF characters occur in the data stream from other sources. They may, for example, come from the remote system: an XON from the remote system, after your modem has sent an XOFF, can result in buffer overflow.

Ctrl-S (XOFF) and Ctrl-Q (XON) characters also occur in binary files, and are used by Xmodem-type protocols. You risk having these characters misinterpreted as modem flow control characters and dropped from the data stream.

Guidelines

If your terminal or software does not support Clear to Send, use of software flow control may prove satisfactory if you're only transferring text files.

However, if you're transferring non-text (binary) files, or using an Xmodem-type protocol, disable flow control entirely (&H0). In addition, be sure the modem is set to &B0 and &N0, so that the DTE and link rates are equal.

RECEIVED DATA FLOW CONTROL

Separate commands, &R*n* (hardware) and &I*n* (software), control the flow of Received Data passed by the Courier to your DTE. Because most computers handle incoming data at a much faster rate than the modem receives it over the phone line, you may want to leave this type of flow control disabled.

Your software and machine must support whichever type you select, although we recommend hardware flow control, if possible. Review the *Settings Supplement* that came with the modem and, if necessary, your software and computer manuals.

Hardware Control (&Rn)

When the DTE drops its Request to Send (RTS) signal, the modem stops passing along received data. The DTE sends RTS again when it is ready to receive.

Your DTE and software must support RTS. You cannot use this type of flow control, however, if your software requires a constant RTS signal.

WARNING: Use this type of flow control only for ARQ (error-control) calls, because under error control the modems use flow control across the phone link. During non-ARQ connections, there is no way to signal the remote modem to stop sending data. If your modem stops passing data to the DTE and the remote modem keeps sending across the link, the Received Data buffer will overflow.

&R0 Delay Clear to Send Response after Request to Send signal (RTS/CTS delay). The delay is required by some synchronous mainframes and does not apply to asynchronous calls. See Chapter 7.

&R1 The modem ignores RTS. Default. This setting is required if your DTE or software does not support RTS.

&R2 Hardware flow control of received data enabled. The modem sends data to the DTE only on receipt of the RTS signal.

Software Control (&In)

When you send the modem a <Ctrl>-S (XOFF) command from the keyboard, the modem stops passing received data to the

DTE. When you send a <Ctrl>-Q (XON) command, the modem resumes. (Hold down the Ctrl key and press the letter. Don't type the angle brackets. The brackets indicate a special, named key on the keyboard.)

WARNING: In ordinary operation, the only characters the modem recognizes during a call are the three pluses (+++) of the escape code. But when software flow control is enabled, the modem also looks for <Ctrl>-S or <Ctrl>-Q characters. If these characters occur in a file or as part of a protocol, the modem reads them as XON/XOFF characters and acts on them. In some cases, the modem drops them from the data stream.

&I0 Disables XON/XOFF flow control of received data. Default. Recommended for non-ARQ (Normal mode) calls, but see &I5. The I0 option provides transparency for all characters except the escape code sequence (+++), because at this setting the modem does not look for control characters.

NOTE: Because of the risk described in the above warning, the settings that follow are only recommended for users whose data does not include XON/XOFF control characters.

&I1 The Courier acts on your typed XON/XOFF commands, and passes them to the remote computer. Use in ARQ mode only, but keep in mind that the XON/XOFF characters sent to the remote computer may interfere with XON/XOFF signaling between the remote computer and remote modem. See &I2.

&I2 The Courier acts on your XON/XOFF commands, but removes them from the data stream instead of passing them to the remote computer. This ensures that the remote computer does not confuse your XON/XOFF characters with those from its attached modem. This is the recommended setting for ARQ mode.

However, if the call is not in ARQ mode, there is no flow control on the phone link. If you send an XOFF to your modem and it stops passing data, it has no way to tell the remote computer and modem to stop sending for a while, and your modem's buffer may overflow. For more reliable control in non-ARQ mode, see &I5.

&I3 Hewlett Packard—Host Mode. Applies only to modems attached to an HP mainframe that uses the ENQ/ACK protocol. See Appendix E.

&I4 Hewlett Packard—Terminal Mode. Applies only to modems attached to terminals in an HP system that uses the ENQ/ACK protocol. See Appendix E.

&I5 This setting is designed to enable flow control on the phone link when the connection is not under error control. For this to work for you, the remote modem must have &I5 capability.

In ARQ mode, a Courier set to &I5 operates the same as it does when set to &I2. It acts on your XON/XOFF commands, but does not pass them to the remote system. The error control protocol enables the modems to control the flow of data on the phone link.

In non-ARQ mode, a Courier set to &I5 operates as though flow control were disabled (&I0): it does not look for your typed XON/XOFF commands. However, it looks for XON/XOFF characters *coming in over the phone link.* When the remote operator sends XON/XOFF commands, the Courier either resumes or stops transmitting data over the link and drops the characters from the data stream.

If both modems are set to &I5, operators at each end can signal the remote modem to stop sending, thereby controlling the data flow on the phone link and preventing their own modem's buffer from overflowing. At the DTE/DCE interfaces, the modems independently control the flow of data through their Transmit Data (&H) settings.

Guidelines

Use of software flow control may prove satisfactory if you're only transferring text files. However, if you're transferring non-text (binary) files, or using an Xmodem-type protocol, disable flow control entirely (&R1, &I0). In addition, set the modem to &B0 and &N0, so that the DTE and link rates are equal.

DATA COMPRESSION (&Kn)

When data compression is enabled, the transmitting modem detects redundant bits of data and recodes them into shorter units of fewer bits. The receiving modem decompresses the redundant data units before passing them to the receiving DTE.

Compression does not occur unless the modems are able to establish an error control connection. In addition, the modem should be set for Transmit Data flow control (&H1, 2 or 3), as described earlier in this chapter.

&K0 Data compression disabled.

&K1 Auto enable/disable. This is the default. The modem enables compression if the DTE rate is fixed, &B1, and disables compression if the DTE rate follows the link rate, &B0. The reason is that compression offers no throughput advantage when the DTE and link rates are equal: compression may even degrade throughput.

&K2 Data compression enabled. Use this setting to keep the modem from disabling compression.

&K3 Selective data compression. The modem negotiates only for V.42 *bis* compression, and disables MNP Level 5 (MNP5) compression. Use this setting to transfer 8-bit binary files, .ARC files, and other files that are already compressed. See the note below.

If the Courier is connecting with a V.42 or HST modem, it negotiates V.42 *bis* compression. If V.42 *bis* is not feasible, the connection remains under error control, but without data compression.

If the Courier is connecting with an MNP modem, it negotiates for MNP Level 5 (MNP5) data compression. If the remote modem does not have MNP5, the connection remains under MNP error control, but without compression.

NOTE: MNP5 compression is not useful when transferring files that are already compressed, such as the .ARC files downloaded from many Bulletin Boards and 8-bit binary files, which appear to the modem to be compressed. MNP5 tends to add data to the transmission so that throughput over the link degrades. V.42 *bis* compression dynamically detects when data is already com-

pressed and turns off until it detects that compression will work to advantage. The special &K3 setting enables the best throughput for already-compressed files.

See *Throughput Guidelines* and *Data Compression* in Appendix A for more information, including throughput to expect for different kinds of files.

DATA RATE COMMANDS

The &B*n* and &N*n* commands allow you to select variable or fixed data rates at the DTE and link (modem-to-modem) interfaces. Throughout this manual we recommend that, if your software allows, you select a fixed rate at the DTE interface (&B1) so that it can remain higher than the rate on the phone link.

You'll get greater throughput regardless of the call's rate on the phone link. Just remember to also enable Transmit Data flow control, preferably hardware (&H1).

For the phone link we recommend variable rates (&N0). This enables the modem to switch its link rate to match the rate of a remote modem, no matter what the remote modem's rate is. If the link rate is fixed, for example at 9600 bps (&N6), the modem only connects with modems operating at that rate. Of course, if your application requires connections with modems at only one rate, you may wish to set the modem to a fixed link rate.

Software Requirements

Both variable and fixed rates require communications software support. Most communications programs support variable rates. Not all software supports fixed rates, although this support is increasing in program updates. Check the *Settings Supplement* that came with your modem and/or your software documentation, especially if your software is a later version than the version in the *Settings Supplement*.

DTE RATE SELECT (&Bn)

Use this command to select variable or fixed rates at the DTE interface. Initially, the modem's DTE interface rate depends on your terminal or software setting. The modem detects this rate from the rate at which it receives the AT command. After that, the DTE rate depends on the modem's &B setting, as follows.

&B0 Variable rates. Default. When the modem switches its link rate to connect with a modem operating at a different rate, it also switches its DTE rate. The software or terminal also switches DTE rates to match the link rate. This setting requires variable rates on the phone link, &N0, so that the Courier can switch link rates to match the rate of the remote modem.

&B1 Fixed rate. The modem always communicates with the DTE at the rate at which you have set the terminal or software, regardless of the link rate. For the greatest throughput, set the DTE to 38.4K or 19.2K bps for high speed calls and to at least 9600 bps for 2400-bps calls.

This setting is not affected by the &N setting. However, the DTE rate *must be equal to or higher than* the link rate.

In addition, this setting requires Transmit Data flow control enabled, preferably hardware control (&H1), so that the modem's buffer doesn't overflow.

&B2 Fixed for ARQ calls/Variable for non-ARQ calls. Answer mode only. When the modem goes off hook and connects in ARQ mode, it shifts its DTE rate up to a user-specified rate, for example, 19.2K bps. If the connection is not under error control, the modem behaves as if it were set to &B0 and switches its DTE rate to match the connection rate of each call.

This option is designed for installations such as Bulletin Boards that receive calls from a wide variety of modems, ranging from the very slow to those with the Courier's advanced design.

To implement this feature, set the modem to return ARQ CONNECT result codes, &A1 or &A2, and to Transmit Data flow control, preferably &H1. Set your software to

the desired rate, and send the modem an **AT &B2 [other settings] &W** command string.

The modem stores the rate of the command in NVRAM along with the settings. Each time it makes an ARQ connection, the modem checks NVRAM for the specified DTE rate.

When sending subsequent configurations to NVRAM, be sure your software is set to your selected DTE rate, so that the correct rate is maintained.

Link Rate Select (&Nn)

Use this command to select variable or fixed rates at the link interface. Variable rates allow the modem to connect with a variety of remote modems.

&N0 Variable rates. Default. The Courier negotiates with the remote modem for the highest possible link rate, depending on the capabilities of the remote modem. This is the recommended setting.

&N1-8 Fixed rate. The modem only connects if the remote modem is operating at the same rate. If not, the modem hangs up. If you display the Link Diagnostics screen when the modem hangs up, the modem reports the reason for the disconnect as *Invalid Speed*. To view the diagnostics screen, issue the ATI6 command.

The link rate must always be lower than, or equal to, the DTE rate, never higher. If the link rate is lower than the DTE rate, enable Transmit Data flow control, preferably hardware control (&H1), so that the modem's buffer doesn't overflow.

If you wish, you can filter out calls at other than a specific speed, for security or other reasons, by fixing the link rate.

The options are as follows. Rates above 9600 bps are valid only for V.32 *bis* and HST operations, not V.32 operations.

&N1	300 bps	&N2	1200 bps
&N3	2400 bps	&N4	4800 bps
&N5	7200 bps	&N6	9600 bps
&N7	12.K bps	&N8	14.4K bps

Guidelines For Low-speed Calls

Calls at 300 bps: These guidelines apply to all Courier high speed modems for standard 300-bps calls. The modem must be set to &B1. If your software rate is higher than 300 bps, set the modem for Transmit Data flow control, &H1 or higher. Set a variable link rate (&N0) or, if you know the remote modem is operating at 300 bps, set a fixed link rate of 300 bps (&N1).

NOTE: Substitute the &B0 setting only if the remote modem is operating at 300 bps and the system it is attached to (usually older equipment) operates at 110-300 bps. In addition, set your software to 300 bps if you plan to use the escape code sequence (+++) to hang the modem up or bring it back to Command mode. When set to &B0 and operating at 300 bps, the modem ignores all flow control settings.

Calls at 110 bps: Set the modem to &B0 and &N0, and your software to 110 bps. The Courier then will only connect with a modem that is operating at 110 bps. The modem ignores all flow control settings.

If the Courier is set to &B1 for a 110 bps call, the call will be unsuccessful. When the modem is set to &B1, even if the DTE transmits to the modem at 110 bps, the modem transmits the data over the phone link at 300 bps using Bell 103 modulation.

Data Set Ready (&Sn)

The modem sends the DTE a Data Set Ready (DSR) signal via the RS-232 interface. (Data Set is industry jargon for modem.) Few, if any, commercial communications programs require the modem to control DSR, &S1. Leave the modem set for DSR overridden, &S0, unless you know that your installation requires a different setting.

&S0 DSR is always ON (override). Default.

&S1 In Originate mode, the modem sends DSR after it dials, when it detects the remote modem's answer tone. In Answer mode, the modem sends DSR after it sends an answer tone.

&S2 This option is for specialized equipment such as automatic callback units. On loss of carrier, the modem

sends a pulsed DSR signal with Clear to Send (CTS) following Carrier Detect (CD).

&S3 This is the same as &S2, but without CTS following CD.

DATA TERMINAL READY (&Dn)

This command, like DIP switch 1, controls Data Terminal Ready (DTR) signaling from the DTE to the modem. The modem is factory set with DIP switch 1 UP, for normal operations and the override disabled.

If you want to change the modem's DTR operations during a session, you can either change the DIP switch position or use the &D command. Whichever method you choose, check either the *Settings Supplement* that came with the modem or your communications software manual to see which setting is required.

NOTE: At power-on and reset, the modem operates according to the DIP switch setting. This command is not stored in non-volatile memory as a power-on/reset default.

&D0 DTR override. The modem operates as though DTR is always ON.

&D1 Reserved.

&D2 Normal DTR operations. The terminal or computer must send a DTR signal for the modem to accept commands. Dropping DTR terminates a call.

CARRIER DETECT (&Cn)

This command, like DIP switch 6, controls Carrier Detect (CD) signaling from the modem to the DTE. The modem is factory set with DIP switch 6 UP, normal CD operations and the override disabled.

If you want to change the modem's Carrier Detect operations during a session, you can either change the DIP switch position or use the &C command. Whichever method you choose, check

either the *Settings Supplement* that came with the modem or your communications software manual to see which setting is required.

NOTE: At power-on and reset, the modem operates according to the DIP switch setting. This command is not stored in non-volatile memory as a power-on/reset default.

&C0 CD override, CD always ON.

&C1 Normal CD operations. The Courier sends a CD signal when it connects with another modem and drops CD on disconnect.

RACK CONTROLLER UNIT ACCESS (%Rn)

If the Courier modem is part of a USRobotics Total Control Modem Management System, setting the modem to %R1 allows an operator to use the modem to call a Rack Controller Unit (RCU) at a remote site.

%R0 Normal operations, RCU access disabled. This is the default.

%R1 RCU access enabled.

TOUCH-TONE RECOGNITION (%T)

This command enables the modem, when off hook, to detect the Touch-Tone frequencies of dialing modems. %T is meant primarily for use with network applications, but may also be integrated into certain software programs. For example, %T could be used in a security program to identify incoming Touch-Tone security codes.

To enable this feature, type ATH1 <Enter> to force the modem off hook. Then type AT%T <Enter>.

To return the modem to Command mode, press any key or drop the DTE's DTR signal. The modem responds OK.

CHAPTER 5. INTERNAL CONTROLS

The commands explained in this chapter are of two types. The first group concerns default configurations, for example, writing your own power-on defaults to nonvolatile random access memory (NVRAM). The remaining commands are used to select the modem's local operating characteristics, for a current session or to include in your default configuration. They include result code, echoing, and other options.

NOTE: When you change a default setting during a session, the modem retains that setting until you do one of the following.

- Change the setting.
- Issue the ATZ command to reset the modem to its software defaults. If DIP switch 10 is UP, the modem resets to the defaults stored in nonvolatile memory (NVRAM). If DIP switch 10 is DOWN, the modem resets to the factory settings stored in read only memory (ROM).
- Issue the AT&F command to load the modem's factory settings.
- Turn the modem off and power it on again. At power-on, the modem loads either the nonvolatile memory defaults (DIP switch 10 UP) or the factory settings (DIP switch 10 DOWN).

SETTING/USING DEFAULTS

The modem's read only memory (ROM) permanently stores the modem's factory settings. The inclusion of nonvolatile random access memory (NVRAM) allows you to define your own configuration and write the settings to NVRAM as your power-on defaults.

WRITING DEFAULTS TO NVRAM (&W)

When you power on the Courier, it loads the settings stored in NVRAM if DIP switch 10 is UP (factory setting). Until you write your own settings to NVRAM, the defaults stored there are the same as the permanent ROM factory settings.

You'll find a list of NVRAM options and factory settings in Appendix B. You can also display them by selecting option 5 of the I (inquiry) command:

ATI5 <Enter>

If you've sent the modem commands to change settings throughout your session and want to save your current configuration, send just the &W command. The current settings are saved.

AT&W <Enter>

You may also specify the entire configuration in a single command string that ends with the &W command. The following example sets the modem for the current session and stores the configuration in NVRAM.

AT X4 &B1 &H1 M3 &W <Enter>

After sending a configuration to NVRAM, you can change any setting just for the current session, as in the following example. The NVRAM configuration remains intact.

ATX7 <Enter>

But if you want the new setting to be a default, write it to NVRAM at the same time, as in the following example. X7 is substituted for the X4 setting stored earlier.

AT X7 &W <Enter>

LOADING THE FACTORY DEFAULTS (&F)

If DIP switch 10 is DOWN, the factory settings are loaded at power-on instead of the NVRAM defaults. Factory settings for the options that are stored in NVRAM are in Appendix B.

If the NVRAM defaults are loaded at power-on (DIP switch 10 UP) and you want to load the factory defaults instead, use the following command:

AT&F <Enter>

If NVRAM defaults are loaded, but you want to view a screen listing of factory defaults, first load them (&F), to make them the

current settings. Then include the I4 inquiry option to display a listing of the newly current settings, as in the following example.

AT&F I4 <Enter>

To restore your NVRAM defaults, use the ATZ command described next. (DIP switch 10 must be UP.)

RESET (Z)

If you've changed several current settings and want to reset to your power-on defaults, type the following command:

ATZ <Enter>

The modem reads its DIP switch settings and resets either to its NVRAM defaults (DIP switch 10 UP) or factory settings (DIP switch 10 DOWN).

NOTE: Use the ATZ command also if you've changed the position of DIP switches 2-5, 7 or 9 while the modem is on, so that the modem can read the new setting. The only other way to initiate a new setting for switches 2-5, 7 and 9 is to turn the modem off and on again.

STORING TELEPHONE NUMBERS (&Zn=s)

The modem stores up to four frequently dialed phone numbers. Write the numbers to NVRAM with the &Z*n*=*s* command, where *n* is position 0 through 3, and *s* is the phone-number string.

The number-string may be up to 36 characters long, including any Dial command options. The following example includes the tone-dial (T) and wait for a second dial tone (W) options of the Dial command. The number is stored at position 0, assumed because there is no *n* parameter.

AT&Z=T9W5551234 <Enter>

The following example stores a long-distance number at the second position. We've added spaces for readability.

AT&Z2=1 516 555 1234 <Enter>

The DS*n* command is used to dial a stored number, as in this example to dial the number stored at position 2:

ATDS2 <Enter>

NOTE: Do not include modem settings in the &Z string. If the call requires a special setting, insert it in the command string before the DS*n* command. In the following example, &M0 (no error control) is inserted before the Dial command:

AT&M0 DS2 <Enter>

The previous command establishes &M0 as the current setting. To return to the default error control mode, issue the following command:

AT&M4 <Enter>

RESULT CODES

Four commands control the result codes that the modem returns to the screen:

V*n* Numeric/verbal response mode

Q*n* Display/suppress all result codes

&A*n* Display/suppress additional result code subsets

X*n* Result code subset

Response Modes (Vn)

Result codes are sent to the screen in either words (Verbal Mode) or numbers (Numeric Mode). The Courier is factory set to Verbal mode when it is powered on (DIP switch 2 is UP). Use the V*n* command to select verbal or numeric result codes for a current session, independently of the DIP switch setting.

At power-on and reset, the modem operates according to the DIP switch setting. The V*n* command is not stored in nonvolatile memory as a power-on/reset default.

V0 *Numeric Mode.* Numeric result codes are followed by a Carriage Return but no Line Feed, as in the following example, where a 3 is returned (for NO CARRIER).

ATD1234567 <Enter>
becomes
3TD1234567 <Enter>

V1 *Verbal Mode.* Verbal responses are preceded and followed by a Carriage Return and a Line Feed, as in the following example:

ATD1234567 <Enter>
NO CARRIER

Quiet Mode (Qn)

Enable/suppress the display of result codes. The Courier is shipped with DIP switch 3 DOWN, to display result codes. Use the Q*n* command to control the display for a current session, independently of the switch setting.

At power-on and reset, the modem operates according to the DIP switch setting. The Q*n* command is not stored in non-volatile memory as a power-on/reset default.

Q0 Result codes are displayed.

Q1 Result codes are suppressed (made quiet).

Q2 Result codes are suppressed only in Answer mode.

Additional Result Code Subsets (&An)

Use this command to enable/disable one of the following subsets of error control, modulation or protocol result codes.

&A0 ARQ (error control) codes are disabled. This setting does not affect an error-control connection; the modem returns the standard CONNECT messages if result codes are enabled.

&A1 ARQ codes are enabled. One of the following results is sent to the screen when a successful error control connection is established. Message 14 is displayed if the modem is set to X0 and the connection is at any rate from 1200 to 14.4K bps. The remaining results indicate the connection rate and require a setting of X1 or higher.

14/CONNECT/ARQ	19/CONNECT 4800/ARQ
15/CONNECT 1200/ARQ	22/CONNECT 12000/ARQ
16/CONNECT 2400/ARQ	24/CONNECT 7200/ARQ
17/CONNECT 9600/ARQ	26/CONNECT 14400/ARQ

&A2 HST/V32 modulation codes are enabled. This option is included for users of HST Dual Standard modems. If your software cannot handle the added modulation information, select &A1 or &A0.

23/CONNECT 9600/HST	or	33/CONNECT 9600/V32
27/CONNECT 9600/ARQ/HST	or	37/CONNECT 9600/ARQ/V32
28/CONNECT 4800/HST	or	38/CONNECT 4800/V32
29/CONNECT 4800/ARQ/HST	or	39/CONNECT 4800/ARQ/V32
30/CONNECT 7200/HST	or	40/CONNECT 7200/V32
34/CONNECT 7200/ARQ/HST	or	44/CONNECT 7200/ARQ/V32
31/CONNECT 12000/HST	or	41/CONNECT 12000/V32
32/CONNECT 12000/ARQ/HST	or	42/CONNECT 12000/ARQ/V32
35/CONNECT 14400/HST	or	45/CONNECT 14400/V32
36/CONNECT 14400/ARQ/HST	or	46/CONNECT 14400/ARQ/V32

&A3 Protocol codes are enabled. Error control protocols reported are: HST, LAPM, or MNP. When the call is not under one of those protocols (and ARQ is not included in the result code), the modem reports either SYNC, indicating a synchronous connection, or NONE, for no protocol.

If the modems are using data compression, the type of compression, V42BIS or MNP5, is added to the result code. In the first of the following examples, the modems negotiated error control for the call (ARQ), used HST modulation, are using HST error control protocol, and are using V.42 *bis* compression.

CONNECT 14400/ARQ/HST/HST/V42BIS[or MNP5]
CONNECT 14400/ARQ/V32/LAPM/V42BIS[or MNP/MNP5]
CONNECT 9600/SYNC
CONNECT 2400/ARQ/MNP/MNP5[or LAPM/V42BIS]
CONNECT 2400/NONE

NOTE: Although these codes will return numeric identifiers, they are the same numeric identifiers used for &A2 result codes. If the modem is in Numeric Mode (V0) and set to &A3, you will not be able to differentiate between &A2 and &A3 result codes. &A3 result codes may not be compatible with some software.

Result Code Sets (Xn)

You have eight options, 0 through 7, for selecting the result code subset best suited to your applications.

X0 Basic subset, returns the first five codes (0-4) in the following table.

X1 Extended subset, codes 0-5, 10, 13 and 18. Default. This set adds rate-specific CONNECT messages to the Basic set.

X2-7 These options include the X1 subset and offer advanced call-progress codes and functions.

	Setting							
Result Codes	**X0**	**X1**	**X2**	**X3**	**X4**	**X5**	**X6**	**X7**
0/OK	•	•	•	•	•	•	•	•
1/CONNECT	•	•	•	•	•	•	•	•
2/RING	•	•	•	•	•	•	•	•
3/NO CARRIER	•	•	•	•	•	•	•	•
4/ERROR	•	•	•	•	•	•	•	•
5/CONNECT 1200		•	•	•	•	•	•	•
6/NO DIAL TONE			•		•		•	•
7/BUSY				•	•	•	•	•
8/NO ANSWER				•	•	•	•	•
9/RESERVED								
10/CONNECT 2400		•	•	•	•	•	•	•
11/RINGING						•	•	•
12/VOICE						•	•	
13/CONNECT 9600		•	•	•	•	•	•	•
18/CONNECT 4800		•	•	•	•	•	•	•
20/CONNECT 7200		•	•	•	•	•	•	•
21/CONNECT 12000		•	•	•	•	•	•	•
25/CONNECT 14400		•	•	•	•	•	•	•
Functions								
Adaptive Dialing			•	•	•	•	•	•
Wait for 2nd Dial Tone (W)				•	•	•	•	•
Wait for Answer (@)				•	•	•	•	•
Fast Dial			•		•		•	•

Table 5-1. Result Code Options

NOTE: Additional messages indicate an error-control connection and the modulation for a call. See *Additional Result Code Subsets (&An)*, earlier in this chapter.

Result Code	Meaning
0/OK	Command has been executed
1/CONNECT	Connection established with another modem; if set to X0, connection may be at 300, 1200, 2400 or 9600 bps; if X1 or higher, connection is at 300 bps
2/RING	Incoming ring detected
3/NO CARRIER	Carrier detect has failed or carrier has been dropped due to disconnect
4/ERROR	Command is invalid
5/CONNECT 1200	Connection established with another modem at 1200 bps
6/NO DIAL TONE	Dial tone not detected during the normal 2 seconds, set in Register S6
7/BUSY	Busy signal detect; modem hangs up
8/NO ANSWER	After waiting 5 seconds for an answer, modem hangs up; returned instead of NO CARRIER when the @ option is used
10/CONNECT 2400	Connection established with another modem at 2400 bps
11/RINGING	The modem has dialed; remote phone line is ringing
12/VOICE	Voice answer at remote site; modem hangs up
13/CONNECT 9600	Connection established at reported rate. Same meaning for results of 4800 (18), 7200 (20), 12K (21) and 14.4K (25).
Adaptive Dialing	The modem attempts to use Touch-Tone dialing and, if that doesn't work on the line, reverts to rotary dialing.
Wait for Another Dial Tone (W)	The modem continues dialing as soon as it detects another dial tone. See the dial options in Chapter 6.
Wait for an Answer (@)	The modem continues dialing when it detects 5 seconds of silence on the line. See the dial options in Chapter 6.
Fast Dial	The modem dials immediately on dial-tone detect, instead of waiting the normal 2 seconds set in Register S6.

Table 5-2. Result Code Definitions

LOCAL ECHO

Local echo is the display of what you type at the keyboard and data the Courier transmits to another modem. The E*n* command controls the display of your typed commands, when the modem is in Command Mode. The F*n* command applies to when the modem is online to another system.

Command Mode Local Echo (En)

The E*n* command enables/disables the display of your typed commands. If double characters appear on the screen, both the modem's local echo and your software's local echo are on.

The Courier is shipped with DIP switch 4 UP, enabling local echo. The E*n* command controls the local echo for a current session, independently of the switch setting. At power-on and reset, the modem operates according to the DIP switch setting. The E*n* command is not stored in nonvolatile memory as a power-on/reset default.

E0 Command Mode echo OFF. The modem does not display keyboard commands.

E1 Command Mode echo ON.

Online Local Echo (Fn)

This command causes the modem to display a copy of the data it is transmitting to another system. Many systems, however, return a copy of received data, which is called a remote echo. If the modem's online echo is ON and there is also remote echoing, double characters appear on the screen.

In some microcomputer documentation, the term *duplex* is applied to local online echoing, although the term is not technically accurate.

F0 Online echo ON. Sometimes called *half duplex*. As the modem transmits data to a remote system, it also sends a copy of the data to the screen.

F1 Online echo OFF. Sometimes called *full duplex*. Default.

THE AUDIO MONITOR

The modem's speaker enables you to monitor the dial-connect process. There are several ways to make use of this feature. After the Courier dials a number, it waits 60 seconds for a high-pitched answer tone from the other modem, immediately followed by data signals, called a carrier. These signals must occur before a data link is established.

At the default X1 setting, if someone answers the phone, or if the line is busy, the modem sends the message NO CARRIER to your screen after 60 seconds. If you listen to the speaker, you can respond immediately instead of waiting for the modem to time out.

For example, if you hear someone answering the call, you can pick up the phone, if it's attached to the modem, and talk to the person. Or you can cancel the call by pressing any key on the keyboard. In the same way, you can cancel a call when you hear a busy signal.

You can also hear if dialing is proceeding too quickly for the system. Terminate the call (press any key) and retype the Dial command, but insert a comma (,) or a couple of slashes (/), to have the modem during the dialing process.

SPEAKER CONTROL (Mn)

This command disables the speaker entirely or sets the speaker to monitor different segments of the dial-connect sequence.

M0 This setting disables the speaker entirely so that you don't hear the modem go off hook, dial, etc.

M1 The speaker is ON until Carrier Detect. Default. You can monitor call progress until the Courier detects the remote modem's carrier signals, or until the 60-second timeout and result code display. At Carrier Detect, the modem disconnects the speaker and data transmission sounds are suppressed.

M2 The speaker is ON continuously, including during data transmission.

M3 The speaker doesn't go ON until after the last digit is dialed, then goes OFF at Carrier Detect.

MODEM CLOCK USAGE (Kn)

The modem clock is used as a call-duration timer or as a real-time clock. Used in conjunction with the I*n* (Inquiry) command, the modem returns the duration of the last call in hours, minutes, and seconds or the actual time.

K0 Call-Duration Mode. Default. The modem times each call from CONNECT to NO CARRIER, and stores the information until the next connection or when the modem is reset. At ATI3 <Enter>, the modem displays the call's duration. If you wish, you can maintain a call log by printing this information after each call.

K1 Real-Time Mode. The clock operates as a real-time clock regardless of the presence of a carrier. Set the clock (in military time) by specifying the hour, minutes, and seconds as in the following example, which sets the clock at the real time of 1:30 p.m.

ATI3=13:30:00 K1 <Enter>

At ATI3, the modem displays the real time. You'll need to set the clock each time you power on the modem, but the clock is not affected by the reset command, ATZ.

TRANSMITTER ENABLE/DISABLE (Cn)

If an additional terminal and modem share the phone line for monitoring purposes, the second modem is placed in Receive Only state by disabling its transmitter. Use this feature only at 1200 or 300 bps.

C0 Transmitter disabled. Modem is set to Receive Only.

C1 Transmitter enabled. Default.

BREAK HANDLING (&Yn)

This command allows you to send a break to abort data transfer without disconnecting from the phone link. The following options are available.

&Y0 Destructive, no Break transmitted: the modem clears the data from its transmit buffer (all data is lost) but does not transmit the Break to the remote modem.

&Y1 Destructive, expedited: the modem clears the buffer and immediately sends a Break to the remote modem. Default.

&Y2 Nondestructive, expedited: the modem retains data in the transmit buffer, but immediately sends a Break to the remote modem.

&Y3 Nondestructive, unexpedited (send Break in sequence): the modem transmits any buffer data received before the Break, sends the Break, and then sends any subsequent input from the DTE.

NOTE: If the call is under MNP5 data compression, destructive Breaks cause both modems to reset their data compression tables. When transmission resumes, the modems build new tables, and the result is lower than normal throughput.

S-REGISTERS

The S-Registers are used to set various timing parameters, redefinition of selected ASCII characters, and other configuration options. The defaults reflect typical requirements.

A detailed summary of the S-register functions is in Appendix B. A less detailed summary is in the Quick-Reference card.

CHAPTER 6. ASYNCHRONOUS DIALING AND ANSWERING

The information in this chapter applies to asynchronous calls only. For synchronous operations, refer to Chapter 7.

BEFORE CONNECTING

For two modems to connect and exchange data, they must use the same modulation standard and, for error control to be successful, the same error control protocol. The end-to-end devices (the computers, or DTEs) must use the same word length, parity, and number of stop bit settings.

Modulation/Standards

The Courier modem adheres to the following modulation and signaling standards.

USR-HST	14.4K/12K/9600/7200/4800 bps (Dual Standard and HST modems)
CCITT V.32 *bis*	14.4K/12K/9600/7200/4800 bps (Dual Standard and V.32 *bis* modems)
CCITT V.32	9600/4800 bps (Dual Standard and V.32 *bis* modems)
V.22 *bis*	2400 bps
Bell 212A/ CCITT V.22	1200 bps
CCITT V.23	1200 bps with 75 bps back channel (British phone system)
CCITT V.25	Answer sequence for calls originating outside the U.S. and Canada
Bell 103 or CCITT V.21	300 bps
CCITT V.42	LAPM error control, 1200 bps and higher
CCITT V.42 *bis*	Data compression, 1200 bps and higher
MNP	Levels 2, 3 and 4 error control, level 5 data compression, 1200 bps and higher
CCITT V.54	Analog digital and remote digital loopback testing

Setting the Transmission Rate

Setting your terminal or software to 38.4K or 19.2K bps ensures that the Courier can operate at its highest speed. The modem detects the rate from the AT command and operates accordingly. It also detects your terminal/software settings for the data formats shown below in Table 6.1.

Follow the guidelines in the *Quick Start* in Chapter 3 or the more detailed instructions in Chapter 4 before selecting either variable or fixed DTE rates (&B*n*). Setting the modem to &B1 and your software to a high DTE rate will give you the best throughput. Set the modem for flow control (&H*n*), as well.

We recommend leaving the modem at its link operation factory setting, &N0, unless your application requires that you specify a fixed link rate. &N0 allows the Courier to automatically negotiate with the remote modem for the highest possible link rate.

Data Format

Both modems must use the same 10-bit data format, which you must select through your terminal or software. The formats allowed are as follows:

Start Bits	Data Bits	Parity	Stop Bits
1	7	Even, Odd, Mark, Space	1
1	7	None, Even, Odd Mark, Space	2
1	8	None	1,2

Table 6.1—Allowable Data Formats

Error Control

For reliable high speed data transfer, always set the Courier for error control, &M4 (the default) or &M5, for calls above 2400 bps. Most users communicating with V.42- or MNP-compatible modems will want error control at 2400 and 1200 bps as well.

It is a good idea to find out if the remote modem is MNP-compatible. Some public network services, for example, are not. If the remote modem doesn't have MNP capability, it may misinterpret the error control request and block a successful connection. If you know the remote modem doesn't support MNP, disable MNP handshaking by setting Register S27 to 16. The modem still connects with V.42-compatible modems.

PLACING CALLS

The commands discussed in this section are used in the following operations:

Dialing	D (0-9 # * , ; ! P T W @ R), DS*n*
Redialing	A/, A>, >
Canceling dialing	<any key>

Dial (D)

When the Dial command is issued the modem goes off hook—the equivalent of picking up your phone—then enters Originate mode and dials the number sequence that follows. The modem also executes any other commands or options included in the command line.

The command string may include up to 40 characters. The modem counts, but ignores punctuation characters such as parentheses and hyphens. It does not count spaces, the AT prefix or the Carriage Return (Enter key) required to execute the command.

The following command example instructs the modem to stop the display of commands (E0, turn off the local echo), turn off the speaker (M0), and dial (D) the phone number (1234567) using Touch-Tone dialing (T). The spaces shown are ignored by the modem and are only included here for readability.

AT E0 M0 DT 1234567 <Enter>

Cancel Dialing

To cancel Dial-command execution, press <any key>. If you inadvertently hit a key on the keyboard while the modem is dialing, the call is canceled. If this occurs, type the A/ command explained under *Redialing* later in this chapter.

Dialing Type, Pulse or Tone

If set to X0 or X1, the modem defaults to pulse (rotary) dialing. To have the modem use tone dialing, which includes the asterisk (*) and pound sign (#), use the T command. The command may be included in the Dial string, as in the previous command example, or issued separately:

ATT <Enter>

The following command resets the modem to pulse dialing:

ATP <Enter>

You can switch from one dial type to another within a dialing sequence.

NOTE: The modem remains set to the dialing type of the last call until it is reset (ATZ command) or it receives a different dial-type command.

Adaptive Dialing (X2—X7)

When any of the X2 through X7 options is in effect and you do not issue a dialing type in the Dial string, the Courier uses tone dialing, which is faster than the default pulse type. However, if the phone company's central office does not have Touch-Tone detection equipment, the modem cannot break dial and continues to detect the dial tone. If this occurs, the modem automatically reverts to pulse dialing.

Pause (,)

A comma causes a two-second delay in the dial sequence. The following example contains four-second delays at several points:

ATDP 9,,7654321,,55555,,1 312 1234567 <Enter>

The first four-second pause is to access an outside line after dialing 9, but you may wish the use the W option, described in what follows. The second pause is to make sure the remote system is ready for the user's account number, and the third, to delay before dialing the long-distance number.

Such pauses, however, may not be necessary. Experiment and use delays only as required.

Slash (/)

A slash (/) can be used in any command string to have the modem pause for only 125 milliseconds. Some users find it helpful to have the shorter delay of a series of slashes, rather than the 2-second comma pause.

Wait for Another Dial Tone (W)

This command is useful in situations where you must wait for a second dial tone before continuing dialing. For example, if you need to dial for an outside line, as in the following example, the Courier continues dialing as soon as it detects the next dial tone.

ATD9W1234567 <Enter>

NOTE: This command executes only if result code option X3 or greater has been issued. If the modem is set to X2 or lower, the modem interprets the W as a comma (two-second pause).

Dial and Return to Command Mode (;)

If your phone is plugged into the modem, you can use this option to have the modem Auto Dial a telephone rather than a modem. The Courier dials, remains off hook and returns the OK message, indicating it is in Command mode.

For example, to have the modem place a voice call, enter the Dial command with a semicolon:

ATDT5551234; <Enter>

When the modem returns the OK result, pick up your phone receiver so you can talk to the other party, and send the command that hangs up the modem:

ATH <Enter>

Similarly, you can call a recorded weather or other service. Have the modem Dial, listen to the recording over the modem's speaker and, when you are finished, tell the modem to hang up.

Dialing Letters (")

Quotation marks are used to have the modem dial abbreviations and acronyms used as phone numbers, such as DIAL USR (the USRobotics Sales Department's 800 number). The option is

called Quote mode. Quotation marks are inserted at the beginning of the alphabetic string:

ATDT"BBS NEWS <Enter>

NOTE: If you are including another command after the dial string, use closing quotation marks before the additional command.

Transferring Calls (!)

This command applies to modems in installations where other modems share the phone line. The modem flashes the switchhook, i.e., goes off hook 0.5 seconds, on hook for 0.5 seconds, and off hook again to dial the specified extension. The following example includes instructions to return to Command mode (;) and to hang up (H).

ATDT !1234;H <Enter>

Wait for an Answer (@)

Some online services answer the phone and return a tape-recorded request for information before processing transactions. In such instances, the @ command can be used in the Dial string to tell the modem to detect at least one ring, wait for five seconds of silence at the other end of the call, and then continue to execute the Dial string.

To use the @ command, set the modem to X3, X4 or X7. If the modem is set to X2 or lower, the modem returns an ERROR message when encountering the @ character in a command string. If set to X5 or X6, the modem hangs up when it detects a voice answer and sends the VOICE result code.

In the next example, the modem is set to the X4 result code option and dials a banking service. Each occurrence of @ in the example indicates a five-second wait for silence, that is, for taped requests from the bank for a password (12345), an account number (6789) and a transaction code (2). The transaction code might indicate, for example, a request for an account balance.

ATX4 DT5551234 @ 12345 @ 6789 @ 2 <Enter>

If the necessary conditions do not occur—no rings, or no following five seconds of silence—the modem times out as it normally

would (after 60 seconds). It then sends the message NO ANSWER to the screen and aborts the command.

Reversing Originate/Answer Frequencies (R)

This command allows calls to an originate-only modem. It reverses the modem's originate/answer frequencies, forcing the Courier to dial out at the answer frequency. The command follows the Dial command, before or after the phone number:

AT D1234567R <Enter>
AT DR1234567 <Enter>

Dialing a Stored Number (DSn)

Chapter 5 includes instructions for storing up to four telephone numbers in nonvolatile random access memory (NVRAM). To have the modem dial a stored number use the DS*n* command, where *n* is the number's position, 0-3, in NVRAM. In the first of the next two examples, the phone number is stored at position 0, assumed by the modem if there is no numeric parameter:

ATDS <Enter>
ATDS3 <Enter>

You can store a partial dial sequence, for example, the phone number of a system, to which you might want to add different codes for different extensions. Store the phone number so that you don't have to type it each time. Use the DSn command to dial the number; then have the modem dial whichever code you want, as in the following example. The phone number is stored at position 1. Spaces in the command string are included here only for readability.

AT DS1 D5678 <Enter>

REDIALING

The most frequent reason for redialing is receipt of a busy signal. The Courier provides three ways to redial, as follows.

Dial the Last Dialed Number (DL)

When sent this command, the modem dials the last dialed number, which it has stored in a special buffer:

ATDL

To display the number stored in the last-dialed buffer, use the following command:

ATDL?

To write the last number dialed to NVRAM, use &Z*n* = L where *n* is the position in NVRAM. The following example stores the last dialed number at position 3:

&Z3 = L

If a number is already stored at position 3, that number is over-written with the last-dialed number.

Re-execute the Last Command (A/)

The A/ command, which does not take the AT prefix or a Car-riage Return, redials one time:

A/

When the modem receives a command, it stores the instruction in its command buffer until it receives the next AT command. Note that if you've sent the modem an additional command since the Dial command, A/ re-executes that command instead of redialing.

Automated Redialing (>, A>)

These two commands, while they can be used to continuously repeat any command, are designed for automated redialing. The first (>) is included in the Dial command. The second (A>) is used alone to continuously redial the command string in the buffer.

Continuous Repeat (>)

If you know the modem you are calling is frequently busy, include the Repeat command in the Dial string, as follows:

AT > DT 1234567 <Enter>
AT DT 1234567 > <Enter>

The modem enters Repeat mode, dials the number, waits the default 60 seconds for a carrier, and hangs up. Then, after a two-second pause, it redials.

The cycle continues until the modems connect or the modem reaches a maximum of 10 attempts. The 10-try limit is mandated by the Canadian Department of Communications (DOC) to prevent tying up local telephone company exchanges with unconnected calls.

Continuous Re-execute (A>)

This command combines the features of both the A/ and > commands. The modem enters Repeat mode as described above, and redials the Dial string in the command buffer. Like the A/ command, A> does not take the AT prefix or a Carriage Return:

A>

Exiting Repeat Mode

Should you use > or A> with a command other than a Dial string, abort the cycle by pressing <any key>.

To abort automated redialing, be sure to press <any key> when the result code appears, during the pause before the modem begins dialing again. If you press <any key> while the modem is dialing, that dial attempt is canceled but the cycle continues.

ESCAPE CODE OPERATIONS (+++)

Once the modem is online to another system, the only command it recognizes is an escape code of three pluses, which forces the

modem back to Command mode. Do the following when issuing the command:

- Wait one second after sending the last item of data
- Type: +++
- Wait one second before typing any data

Do not type the AT prefix or a Carriage Return. The guard time of one second before and after the code prevents the modem from misinterpreting the occurrence of +++ in the transmitted data stream.

If necessary, the character used in the escape code or the duration of the guard time can be changed by resetting Register S2 or S12. See the *S-Register Summary* in Appendix B.

Modem Response to +++

The modem returns to Command mode when it detects the escape code. However, it keeps the line open or hangs up, depending on the setting of DIP switch 9:

DIP Switch 9	Response to +++
UP	Modem goes on hook (hangs up), sends NO CARRIER result code (factory setting)
DOWN	Modem maintains connection (Online-Command mode), sends OK result code

The factory setting (UP) forces an automatic disconnect when you issue +++. An advantage of this is that you are not likely to inadvertently run up an all-night phone bill.

Set DIP switch 9 DOWN if you want the modem to respond to +++ by entering Online-Command mode, enabling it to execute commands and return online. (See the O command, below.)

WARNING: *For unattended modem operations:* in rare instances, the modem may fail to recognize the +++ escape code sequence. If you are running the modem under software control for unattended operations, we suggest you use the surefire method of dropping the DTR signal from the DTE for at least 50 milliseconds, to ensure against costly phone charges. Methods of turning the DTR signal off—for example, closing the communications port—differ from one computer to another.

RETURNING ONLINE (O)

If DIP switch 9 is DOWN (on detection of the escape code the modem maintains the connection), you can issue commands and then toggle the modem back online with the O command, as in this example:

AT Q1 O <Enter>

HANGING UP (Hn)

If DIP switch 9 is DOWN (factory setting), the escape code forces the modem back to Command mode but leaves the line open. If you want the modem to hang up, issue the following command once the modem sends the OK result code.

ATH <Enter>

If DIP switch 9 is UP, the modem automatically hangs up on receipt of the escape code.

AUTOMATIC ANSWERING

The Courier is shipped with DIP switch 5 DOWN, Auto Answer suppressed. To set the modem to automatically answer incoming calls, do one of the following:

1. Before powering on your system, set DIP switch 5 UP. When you turn the computer on, the modem answers incoming calls on the first ring.
2. When the modem is on, use software control. The following command instructs the modem to answer on the first ring. (You can substitute a higher value. See the S-Register summary in Appendix B-5.)

   ATS0=1 <Enter>

When the modem senses a call coming in, it sends the result code RING to your screen, goes off hook, and sends the remote modem a high-pitched answer tone. If there is no Carrier Detect within 60 seconds, the modem hangs up. If the connection is made, the modem sends a CONNECT result code. When the call is disconnected by you or the remote user, the modem hangs up and returns the NO CARRIER code.

Suppressing Auto Answer

To disable Auto Answer, reverse Steps 1 or 2 above. Set DIP switch 5 DOWN before powering on the modem or set the modem to answer on zero rings:

ATS0=0 <Enter>

Points to Remember

1. If the modem is attached to a computer, you can set the modem to receive calls when you're not at your computer. Load your communications software as you normally do, and set the modem to Auto Answer. Also set your software's file-save function to save incoming messages and/or files.
2. If you've attached your phone so it can be used for conventional calls, disable Auto Answer when you are not expecting incoming data calls. Otherwise, your modem may answer the phone before you do, greeting a voice caller with a high-pitched, irritating answer tone.

INTERNATIONAL CALLS

There are three commands that apply to international calls at 1200 bps and above.

NOTE: To call or answer overseas modems at 300 bps, set the modem to CCITT V.21 mode. See Register S27 in Appendix B.

Handshaking Options (Bn)

This command is used primarily to select HST or V.32 *bis* operation. However, to answer international calls, use the B0 setting, as described below.

B0 This setting is required for V.32/V.32 *bis* operation. It also selects the CCITT V.25 answer tone used outside of North America. This answer tone is incorporated into the V.32/V.32 *bis* recommendations.

This setting is the default for the Courier V.32 *bis* and Dual Standard modems. All you need to do is make sure that the modem is set for Auto Answer (ATS0=1).

Set Courier HST modems to B0 to answer HST-mode international calls. The B0 setting does not affect the modem's ability to call or answer domestic modems. It takes slightly longer, however, to connect.

B1 This setting is required for HST operation. It also selects the Bell 2225 Hz answer tone used in the U.S. and Canada. This is the default setting for the Courier HST.

Guard Tone (&Gn)

This setting applies only to overseas calls at 2400 or 1200 bps. British phone switching systems require the modem to send an 1800 Hz guard tone after it sends an answer tone. Some other European phone networks require a 550 Hz guard tone. Guard tones are not used in the United States or Canada.

&G0 No guard tone, U.S./Canada. Default.

&G1 550 Hz guard tone follows answer tone.

&G2 1800 Hz guard tone follows answer tone, United Kingdom and some Commonwealth countries. Requires B0 setting.

Pulse Dial Make/Break Ratio (&Pn)

This command sets the ratio of the off-hook/on-hook (make/break) interval for pulse dialing. The default sets the modem for use in North America. The ratio must be changed if the modem is used in the United Kingdom and some Commonwealth countries.

&P0 Make/break ratio, U.S./Canada: 39%/61%. Default.

&P1 Make/break ratio, United Kingdom, some Commonwealth countries: 33%/67%.

CHAPTER 7. SYNCHRONOUS OPERATIONS

OVERVIEW

Synchronous mode is required for users who need to call, or receive calls from, a *Host* computer of a large network. The Host is usually a mainframe. The user's device is often called a terminal, even if it is a powerful personal computer.

NOTE: The term *DTE* in the following discussion means Data Terminal Equipment, the end-to-end equipment involved in data communications. DTE denotes your terminal or computer and the remote computer.

Data Rate Synchronization

During synchronous operations, transmit and receive clocks at both ends of the phone link control the precise timing of the data flow. The communications equipment at the remote DTE (the modem and network software) and your modem and DTE must all handle the data at the same speed.

Protocol Compatibility

The devices at both ends of the link must also use the same protocol. These devices are exclusive of the Courier modem, which is transparent during synchronous communications. The Courier's V.42 and MNP error control capabilities are not used.

The link protocol may be SDLC (Synchronous Data Link Control), HDLC (High-Level Data Link Control), BISYNC (Binary Synchronous Control) or another protocol determined by the mainframe manufacturer. These protocols format the data into blocks or frames, add control information, and usually provide error control.

REQUIREMENTS

Courier modems in asynchronous mode adapt to many conditions of remote asynchronous modems. But synchronous connections to a mainframe require strict adherence to specific operating parameters. If you are operating a terminal (not a personal computer) designed for a particular network, you probably need only set the Courier properly before calling or

answering. If you have a personal computer, however, you must find out what hardware and software you need before setting the Courier for synchronous calls.

What You Need to Know

The network's communications management staff can supply information on the following requirements:

- The protocol needed for your calls
- The software support needed to log into the network, for example, a specific communications package or interface board
- The phone number, if you will be calling instead of answering
- Whether you need to change the duration of the modem's Request to Send/Clear to Send (RTS/CTS) delay. Once the Courier establishes a synchronous connection, it waits 10 milliseconds (the default value) after receiving an RTS signal from the DTE before responding with a CTS signal.

  If it's necessary to change the duration of the RTS/CTS delay, you need to reset Register S26. See the *S-Register Summary* in Appendix B.
- Any restrictions about when you can call

The RS-232 Interface

Transmit and Receive synchronous timing pins are required at the RS-232 interface. You'll need either pin 15 or pin 24 for Transmitter timing signals, depending on whether the modem (pin 15) or the DTE (pin 24) generates the signals. You'll also need pin 17, for Receiver timing signals. If you're using an interface adapter card, described below, the adapter will implement these pins. If you're building your own cable, review the *RS-232 Interface*, in Appendix B.

The Synchronous Adapter Card

As a rule, personal computers do not support synchronous communications. You will probably have to purchase and install

a synchronous adapter card. These cards are multifunction boards that provide the following functions:

- A synchronous port from the DTE to the modem.
- One or more synchronous protocols. Be sure to find out which protocol the Host mainframe requires before you purchase an adapter.
- Additional software functions. For example, you need to identify the type of computer or terminal you are using to the mainframe software. You will most likely also have to specify your application, that is, identify the mainframe resources you want to use.

SETTING THE MODEM

Once the modem is in synchronous mode it no longer recognizes commands. Before attempting to connect in a synchronous network, use the following instructions to configure the modem while it is still in asynchronous mode.

NOTE: Be sure that DIP switch 1 is UP (factory setting). The Data Terminal Ready (DTR) override must be OFF so that the Courier detects when the DTE raises and lowers the DTR signal.

To set the modem, follow the instructions for issuing commands to the modem that are in Chapter 2, *Testing the Installation*. Commands begin with a required AT prefix and end with a required Carriage Return, which we denote with the symbol <Enter>. For example, the following command sets the modem to synchronous mode:

AT &M1 <Enter>

Modulation/Link Rate (Bn, &Nn)

Use the following guidelines for your Courier type.

V.32 bis modems: If the modem is connecting with another USRobotics V.32 *bis* modem, set both modems to B0 and to a variable link rate, &N0. The modems will connect at the highest possible rate.

If the Courier V.32 *bis* is to connect with a V.32 modem, set the Courier to B0 and try a variable link rate first, &N0. If that

doesn't work, try a fixed link rate of &N6 (9600 bps) or &N3 (2400 bps).

HST modems: We do not recommend synchronous communications for these modems because of their asymmetrical modulation, unless you are connecting with another USRobotics HST modem. In that instance, set both modems to B1.

For high speed connections with another HST modem, set both modems to a fixed link rate, &N6 (9600 bps) or &N8 (14.4K bps). Find out first, however, if the Mainframe accepts the 14.4K link rate. For 2400-bps connections and lower, set both modems to a variable link rate, &N0.

Dual Standard modems: Set the Dual Standard modem to B0. Try a variable link rate setting (&N0) first. If that doesn't work, you may have to set a fixed link rate, for example, &N6 (9600 bps).

Flow Control

Only the following Courier settings are allowed: &H0 or &H1, &I0, &R0 or &R1. See Chapter 4 for more information on flow control settings.

Transmit Clock Source (&Xn)

This setting specifies whether the Courier or your DTE generates the Transmit clock timing signals for a synchronous call. Most users will require the default setting, &X0.

&X0 The Courier is the source of the Transmit clock timing signals and sends them to your DTE over the RS-232 interface. Default.

&X1 The DTE is the source of the Transmit clock timing signals and sends them to the Courier over the RS-232 interface. This setting is used typically in leased line multiplexed operations. (Multiplexors divide the phone channel so that the channel carries several calls at the same time.) We do not recommend this setting for HST modems.

&X2 The Courier's Receiver clock is the source of the timing signals. The signals are looped to the Transmit clock and sent to your DTE over the RS-232 interface. This setting is only used in those systems that require synchronization of

data flowing in both directions. We do not recommend this setting for HST modems.

Synchronous Mode (&M1)

The modem must be set to &M1 for synchronous operation. The modem remains in asynchronous command mode until it makes a synchronous connection with a remote modem. Upon connection, the Courier enters synchronous mode and sends synchronous timing signals to your DTE. Note that the Courier does not respond to commands until it returns to asynchronous Command mode.

DIALING OUT

Be sure you have set the modem correctly for all of the functions just described under *Setting the Modem*, including the &M1 setting. The following is a sample command:

AT &N6 &M1 <Enter>

To call a synchronous Host computer, do the following:

1. Be sure the modem is assembled according to the directions in Chapter 2: a) using the bottom label as a guide, plug one end of the phone cord that came with the modem into the modem jack indicated by the wall jack icon; b) plug the other end of the phone cord into your wall jack; c) plug your phone's cord into the modem's second jack, indicated by the phone icon.
2. Pick up your phone handset and dial the remote system. As soon as you finish dialing, press in the Voice/Data switch. The modem goes off hook in Originate mode and makes the connection. You can hang up your phone.

NOTE: If you've changed the setting of the Voice/Data switch, insert S32=1 in the AT . . . &M1 command string described above. This resets the switch's function, so that when you press the switch, the modem goes off hook in Originate mode.

ANSWERING

You have two options, listed on the next page:

Synchronous Answer Mode

1. Before powering on the modem, set DIP switch 5 UP to enable Auto Answer. Then power on the modem and follow the previous instructions under *Setting the Modem*.

OR

2. When the modem is operating with DIP switch 5 DOWN, Auto Answer suppressed, follow the previous instructions under *Setting the Modem*, but insert S0=1, to enable Auto Answer, in the AT . . . &M1 command string.

The modem responds automatically to an incoming call, enters synchronous mode and, if set to &X0, begins sending synchronous timing signals to your DTE.

HANGING UP

The modem remains online until the remote modem disconnects or your software causes the DTE to drop DTR. The Courier sends the NO CARRIER result code if result codes are enabled, and returns to asynchronous Command mode.

CHAPTER 8. QUERIES AND HELP SCREENS

USER INQUIRIES (In)

The Inquiry command has eight options. The most commonly used options display the following information:

ATI3	Call duration
ATI4	Current settings
ATI5	NVRAM settings
ATI6	Link diagnostics summary

I0 The modem returns a 3-digit product code. If you have a problem and call USRobotics' Technical Support Department, you may be asked for this product code.

I1 The modem performs a checksum of its read only memory (ROM) and returns the result to the screen. This function is used only in factory testing. The modem should always read the same number.

I2 The modem performs a test of its random access memory (RAM) and returns either the OK (0) or ERROR (4) result code, followed by OK when the test is completed. You may want to use this command as a checkpoint if the modem appears to be malfunctioning.

I3 The modem returns the duration of the last call if set to K0. It displays the actual time if set to K1. See the description of the K*n* command in Chapter 5.

I4 The modem displays its current configuration. Figure 8.1 on the following page is an example.

```
ati4
USRobotics Courier 14400 HST Dual Standard Settings...

   B0  C1  E1  F1  M1  Q0  V1  X1
   BAUD=19200  PARITY=N  WORDLEN=8
   DIAL=TONE   ON HOOK   TIMER

   &A1  &B0  &C1  &D2  &G0  &H1  &I0  &K1  &L0
   &M4  &N0  &P0  &R1  &S0  &T5  &X0  &Y1  %R0

   S00=001  S01=000  S02=043  S03=013  S04=010
   S05=008  S06=002  S07=060  S08=002  S09=006
   S10=007  S11=070  S12=050  S13=000  S14=000
   S15=000  S16=000  S17=000  S18=000  S19=000
   S20=000  S21=010  S22=017  S23=019  S24=150
   S25=000  S26=000  S27=000  S28=008  S29=000
   S30=000  S31=000  S32=000  S33=000  S34=000
   S35=000  S36=000  S37=000  S38=000

   LAST DIALED #: 17085551234

OK
```

Figure 8.1—Sample Result of ATI4 Command

I5 The modem displays the configuration stored in nonvolatile random access memory (NVRAM), as in the following example.

```
ati5
USRobotics Courier 14400 HST Dual Standard NRAM Settings...

   DIAL=TONE  B0  F1  M1  X1
   BAUD=19200   PARITY=N  WORDLEN=8

   &A3  &B1  &G0  &H1  &I0  &K1  &L0  &M4  &N0
   &P0  &R1  &S0  &T5  &X0  &Y1  %R0

   S02=043  S03=013  S04=010  S05=008  S06=002
   S07=060  S08=002  S09=006  S10=007  S11=070
   S12=050  S13=000  S15=000  S19=000  S21=010
   S22=017  S23=019  S24=150  S26=000  S27=000
   S28=008  S29=000  S32=001  S33=000  S34=000
   S35=000  S36=000  S37=000  S38=000

   STORED PHONE #0: 13125551234
                  #1: 12025559876
                  #2: 16175554565
                  #3: 5553748

OK
```

Figure 8.2—Sample NVRAM Settings Screen

I6 During a connection, the modem monitors and stores information about link operations. When the call is ended, you can request a diagnostic summary, as in the following example.

```
ati6
USRobotics Courier 14400 HST Dual Standard Link Diagnostics...

Chars sent              13095     Chars Received          1283
Chars lost                  0
Octets sent              5238     Octets Received          513
Blocks sent                69     Blocks Received            7
Blocks resent               0

Retrains Requested          0     Retrains Granted           0
Line Reversals              5     Blers                      0
Link Timeouts               0     Link Naks                  0

Data Compression      V42BIS 2048/32
Equalization          Long
Fallback              Enabled
Protocol              LAPM
Speed                 9600/9600

Disconnect Reason is DTR dropped

OK
```

Figure 8.3—Sample Link Diagnostics Screen (ATI6)

For calls under data compression, the number of characters sent may be less than the number of octets sent, due to buffering operations. Line Reversals only applies to HST-mode operations, when the modems switch the high and low speed channels. At this time, online fallback is only reported Enabled in HST mode.

Most terms used in the display are self-explanatory except for the following:

***Octets*:** Compressed data units. If the number of octets is greater than the number of characters sent, the modems probably used MNP5 compression on an already compressed file, and the result was expanded data.

***Line Reversals*:** The number of times HST-mode modems switched the high and low speed channels.

***Blers*:** Errors in data and protocol blocks. If there were many block errors, your receiver may have experienced problems on the line.

Blocks Resent: These represent blocks the remote modem resent due to the previous category, *Blers*.

***Link Timeouts*:** Protocol detection problems: communications were severed momentarily, and the modems probably recovered. This does not indicate the retry timeout.

***Link Naks*:** Negative acknowledgments (one or more blocks).

***Data Compression*:** Indicates the type of data compression negotiated for the call (V42BIS or MNP5) or NONE. A V42BIS response includes the size of the dictionary and the maximum string length used, for example, 2048/32. See Appendix A for more information.

***Equalization Long/Short*:** Status of S15 bit 0; long if bit 0=0, short if bit 0=1. Short equalization applies only to HST modems.

***Fallback*:** Enabled/Disabled: indicates whether or not the modems negotiated online fallback during the connection sequence.

Protocol: Indicates the error control protocol negotiated (LAPM, MNP, NONE) or SYNC for a synchronous call.

***Speed*:** The last rates at which the receiver/transmitter were operating before disconnecting.

***Disconnect Reason*:** Possible reasons the modem hung up are as follows:

> ***DTR dropped*:** The DTE dropped the Data Terminal Ready signal, terminating the call.
>
> ***Escape code*:** The operator sent the modem the +++ escape code.
>
> ***Loss of carrier*:** The modem detected loss of the remote modem's carrier and waited the duration specified in Register S10 (default is 0.7 seconds).
>
> ***Inactivity timeout*:** The modem detected no activity on the line for the duration specified in Register S19 (default is 0, timer disabled).
>
> ***MNP incompatibility*:** The modem is set to &M5 and the remote modem does not have MNP capability, or there was an MNP negotiation procedure error.

***Retransmit limit*:** The modems reached the maximum of twelve attempts to transfer a data frame without error.

***LD received*:** The remote modem sent an MNP error control Link Disconnect request.

DISC: The remote modem sent a V.42 Disconnect frame.

***Loop loss disconnect*:** The modem detected a loss of current on the loop connecting it with the telephone company central office. This usually occurs because the remote modem has hung up: the central office drops current momentarily when there is a disconnect at the other end of a call. Unless Register S38 is set higher than zero, the modem immediately hangs up at loop loss.

***Unable to Retrain*:** After several attempts, disturbances on the phone line prevented the modems from retraining, and they could no longer transmit or receive data.

***Invalid speed*:** The modem is set to &N1 or higher, for a fixed link rate, and the remote modem is not operating at the same rate.

XID Timeout: The modems failed to negotiate the V.42 Detection (XID Exchange) phase.

SABME Timeout (Set Asynchronous Balance Mode Extended): The modems failed this part of V.42 link negotiation.

Break Timeout: Incompatible processing of a Break signal occurred.

Invalid Codeword: The modem received an invalid V.42 *bis* (compression) frame.

A Rootless Tree: The modem received an invalid V.42 *bis* (compression) frame.

Illegal Command Code: The modem received an invalid V.42 *bis* (compression) frame.

Extra Stepup: The modem received an invalid V.42 *bis* (compression) frame.

I7 The modem returns a product configuration. If you have a problem and call USRobotics' Technical Support staff, you may be asked to read this screen.

S-REGISTER QUERY (Sr?)

This command allows you to view the contents of a particular S-Register, as in the following example that requests the contents of Register S0 ("On what ring will the modem answer?"):

ATS0? <Enter>

PHONE NUMBER QUERY (&Zn?)

At this command, the modem returns the phone number stored in NVRAM at position *n*, as in the following example that includes a sample modem response:

AT&Z3? <Enter>
5551234

LAST-DIALED NUMBER INQUIRY (DL?)

At this command the modem displays the number stored in the last-dialed number buffer:

ATDL?

HELP SCREENS

Courier modems provide four Help screens: summaries of the basic AT command set, extended ampersand (&) command set, S-Register functions, and Dial command options.

Stop/Restart Display

The following command stops the display. Hold down the Control key and type "S":

<Ctrl>-S

To restart the display, use the same command or press <any key>.

Cancel Display

Either of the following commands cancels the display.

<Ctrl>-C

<Ctrl>-K

Basic Command Set ($)

At AT$, the Courier displays a screen that shows a partial summary of the command set. A second screen, activated by pressing any key, shows the remaining commands. The first screen is shown in Figure 8.4.

```
HELP,  Command Quick Reference (CTRL-S to Stop, CTRL-C to Cancel)

&$    HELP, Ampersand Commands       Kn    n=0  Call Duration Mode
%$    HELP, Percent Commands                n=1  Real Time Clock Mode
A/    Repeat Last Command            Mn    n=0  Speaker Off
A>    Continuously Repeat Command           n=1  Speaker On Until CD
AT    Command Mode Prefix                   n=2  Speaker Always On
A     Answer Call                           n=3  Speaker Off During Dial
Bn    n=0  V32 Mode/CCITT Answer Seq On     n=0  Return Online
      n=1  HST Mode/Bell Answer Seq         n=1  Return Online & Retrain
Cn    n=0  Transmitter Off                  n=2  Return Online & Speed Shift
      n=1  Transmitter On            P     Pulse Dial
Dn    Dial a Telephone Number        Qn    n=0  Result Codes Sent
      n=0..9$#TPR,;^W@!()-                 n=1  Quiet (No Result Codes)
DL    Dial Last Phone Number                n=2  Verbose/Quiet On Answer
DSn   Dial Stored Phone Number       Sr=n  Sets Register "r" to "n"
D$    HELP, Dial Commands            Sr?   Query Register "r"
En    n=0  No Command Echo           S$    HELP, S Registers
      n=1  Echo Command Chars        T     Tone Dial
Fn    n=0  Online Echo               Vn    n=0  Numeric Responses
      n=1  No Online Echo                  n=1  Verbal Responses

Strike a key when ready . . .
```

Figure 8.4—Sample Basic Commands HELP Screen

Extended Command Set (&$)

At AT&$, the Courier displays a screen that shows a partial summary of the extended ampersand command set. A second screen, activated by pressing any key, shows the remaining command set. The first screen is shown in Figure 8.5.

```
HELP, Ampersand Commands (CTRL-S to Stop, CTRL-C to Cancel)

&An   n=0  Disable /ARQ Result Codes   &Pn   n=0  N.American Pulse Dial
      n=1  Enable /ARQ Result Codes          n=1  UK Pulse Dial
      n=2  Enable /Modulation Codes    &Rn   n=0  CTS Follows RTS
      n=3  Enable /Extra Result Codes        n=1  Ignore RTS
&Bn   n=0  Floating DTE Speed                n=2  RX to DTE/RTS high
      n=1  Fixed DTE Speed             &Sn   n=0  DSR Always On
      n=2  DTE Speed Fixed When ARQ          n=1  Modem Controls DSR
&Cn   n=0  CD Always On                      n=2  Pulse DSR, CTS=CD
      n=1  Modem Controls CD                 n=3  Pulse DSR
&Dn   n=0  Ignore DTR                  &Tn   n=0  End Test
      n=1  Reserved                          n=1  Analog Loopback (ALB)
      n=2  DTE Controls DTR                  n=3  Digital Loopback (DLB)
&F    Load Factory Configuration             n=4  Grant Remote DLB
&Gn   n=0  No Guard Tone                     n=5  Deny Remote DLB
      n=1  550 Hz Guard Tone                 n=6  Remote Digital Loopback
      n=2  1800 Hz Guard Tone                n=7  Remote DLB With Self Test
&Hn   n=0  Disable TX Flow Control           n=8  ALB With Self Test
      n=1  CTS                         &W    Store Configuration
      n=2  Xon/Xoff                    &Xn   n=0  DCE Synchronous Clock

Strike a key when ready . . .
```

Figure 8.5—Sample Ampersand Commands HELP Screen

Dialing (D$)

At ATD$, the Courier displays this Dial command summary:

```
atd$
HELP, Dial Commands (CTRL-S to Stop, CTRL-C to Cancel)

0-9 Digits to Dial
*   Auxiliary Tone Dial Digit
#   Auxiliary Tone Dial Digit
T   Tone Dialing
P   Pulse Dialing
R   Call an Originate Only Modem
,   Pause (Wait for S8 Time)
;   Remain in Command Mode After Dialing
"   Used to Dial Alpha Phone #'s
W   Wait for 2nd Dial Tone (X3-X7)
@   Wait for an Answer (X3-X7)
!   Flash Switch Hook

OK
```

Figure 8.6—Sample Dial Command HELP Screen

S-Register Functions (S$)

At ATS$, the Courier displays a screen that shows a partial summary of the S-Register functions. A second screen, activated by pressing any key, shows the remaining registers. The first screen is as follows.

```
HELP, S Register Functions (CTRL-S to Stop, CTRL-C to Cancel)

S0  Ring to Answer On                S19 Inactivity Timeout (min)
S1  Counts # of Rings                S20 Reserved
S2  Escape Code Char                 S21 Break Length (1/100sec)
S3  Carriage Return Char             S22 Xon Char
S4  Line Feed Char                   S23 Xoff Char
S5  Backspace Char                   S24 DSR Pulse Time (1/50sec)
S6  Wait Time/Dial Tone (sec)        S25 Reserved
S7  Wait Time/Carrier (sec)          S26 RTS/CTS Delay Time (1/100sec)
S8  Comma Time (sec)                 S27 Bit Mapped
S9  Carrier Detect Time (1/10sec)          1 = V21 Mode
S10 Carrier Loss Time (1/10sec)            2 = Disable TCM
S11 Dial Tone Spacing (msec)               4 = Disable V32
S12 Escape Code Time (1/50sec)             8 = Disable 2100hz
S13 Bit Mapped                            16 = Disable MNP Handshake
      1 = Reset On DTR Loss               32 = Disable V.42 Detect Phase
      2 = Do Originate in Auto Answer     64 = Reserved
      4 = No Pause Before Result Codes   128 = Unusual SW-Incompatibility
      8 = Do DSR On DTR              S28 V32 Handshake Time (1/10sec)

Strike a key when ready . . .
```

Figure 8.7—Sample S-Register HELP Screen

TABLE OF CONTENTS

PART II. REFERENCE

Appendix A—Link Negotiation (Handshaking) and Error Control
Link Negotiation (Handshaking) A-1
HST Mode A-1
V.32 *bis* Mode A-3
Dual Standard Handshaking A-5
Error Control and Throughput A-5
CCITT V.42 Handshaking A-6
MNP Handshaking A-6
Data Compression A-6
Flow Control A-7
Throughput Guidelines A-7
Achievable Throughput A-9

Appendix B—Summaries and Tables
The RS-232 Interface B-2
Front Panel Indicators B-4
DIP Switch Summary B-6
Default Settings B-9
S-Register Summary B-12
ASCII Chart B-21

Appendix C—Alphabetical Command Summary
Basic Command Set C-1
Extended Command Set C-6
Percent Command Set C-11

Appendix D—Problems and Solutions D-1
If You Still Have Problems D-4

Appendix E—Additional Operations
Voice/Data E-2
High Speed/Low Speed Protocol E-5
Dedicated Line and Leased Line Operation E-8
Hewlett Packard 3000 Installations E-11
MI/MIC Operations E-12

Appendix F—Modem Testing
Testing with &T F-1
Ending a Test—&T0, S18 F-1
Analog Loopback—&T1, &T8 F-2

&T2 F-4
Digital Loopback—&T3 F-4
&T4, &T5 F-5
Remote Digital Loopback—&T6, &T7 F-5
Testing with Register S16 F-8
Analog Loopback—S16=1D F-8
Dial Test—S16=2 F-9
Test Pattern—S16=4 F-9
Remote Digital Loopback—S16=8 F-10

Appendix G—Glossary G-1

Appendix H—Technical Specifications H-1

Index

APPENDIX A. LINK NEGOTIATION (HANDSHAKING) AND ERROR CONTROL

This appendix includes detailed information on how USRobotics HST and V.32 *bis* modems negotiate with remote modems for the rate and other characteristics of each connection. You may find it helpful if you are having difficulty connecting with another modem.

In addition, you'll find information on error control and, especially useful, some statistics and guidelines on using the modem for the best throughput.

The following text relies on familiarity with two terms used in this manual, *ARQ* and *DTE*. ARQ (automatic repeat request) designates a connection under error control. DTE (data terminating equipment) means the computer or terminal to which the modem is attached.

LINK NEGOTIATION (HANDSHAKING)

During high-speed link negotiation, timing and procedures depend on whether the modem uses HST or V.32 *bis* modulation, as follows.

HST Mode

DTE rate: 38.4K/19.2K/9600 bps (38.4K or 19.2K required for 14.4K calls)
Modem settings: B1, &B1, &H1/&H2/&H3, &M4/&M5, &N0

1. The modems begin handshaking by training (synchronizing) at 2400 bps and exchanging information on their error control, data compression, and speed capabilities.

2. Once the modems enable error control, handshaking proceeds as follows. If the remote modem is operating at 2400 bps or lower, the Courier stays at 2400 bps or falls back to match the remote modem's slower rate.

   If the remote modem is HST-compatible and operating at a higher speed, both modems shift up and train at 9600 bps. From there, if possible, they shift up again to 12K bps and

again to 14.4K bps. Or they fall back to 7200 bps and again to 4800 bps, if the remote modem is operating at one of those lower speeds.

Initially, the high-speed channel is allocated to the answering modem, the 450-bps channel to the calling modem. This allocation reverses if the calling modem has more data to transmit than the answering modem.

Specialized High-Speed Connect

It's possible for two modems in HST mode to connect directly at 9600, 12K or 14.4K bps, without 2400-bps handshaking. However, this is only recommended for faster connections in specialized installations where the computer and software manage error control. The reason is that there can be no error control because HST modems negotiate error control during 2400 bps handshaking.

Both modems must be set as follows. High speed handshaking requires a fixed link rate: the modem only connects if the remote modem is operating at the same link rate—9600 (&N6), 12K (&N7), or 14.4K bps (&N8).

DTE rate: 38.4K/19.2K/9600 bps (38.4K or 19.2K required for 14.4K calls)
Modem settings: B1, &B1, &H1/&H2/&H3, &M0, &N6/&N7/&N8

HST Mode, Error Control Disabled

If error control is disabled—that is, the Courier HST is set to &M0 or the remote modem isn't set for error control and the Courier HST reverts to &M0—the Courier operates in one of the following ways.

1. If set to &N0, it only connects at 2400 bps or lower. This ensures that there will not be data transfer at high speeds unless the call is protected by error control.

   Courier HST modems negotiate error control during 2400 bps handshaking. If they cannot connect under error control, they stay at 2400 bps. Or, if the remote modem is operating at a lower rate, the Courier HST switches to the lower rate.

2. If set to &N6, &N7 or &N8, the Courier will handshake at the higher speed, 9600, 12K or 14.4K bps, as shown in the previous configuration example, *Specialized High-Speed Connect*. However, that configuration example should only be used in the special situation described, where the system takes care of error control.

NOTE: Without error control, there are no high speed line reversals. The high speed channel is always allocated to the answering modem. Also, there is no online fallback to protect the connection on impaired lines.

V.32 bis Mode

The handshaking described immediately following this paragraph adheres precisely to the CCITT recommendation. In addition, USRobotics V.32 *bis* modems, *when connecting with each other*, use an enhanced proprietary handshaking procedure which allows them to connect faster and to retrain faster during calls. They must, however, establish a V.42 error control connection. This proprietary handshaking is described after the next section, under *USRobotics V.32 bis to V.32 bis*.

V.32 bis

NOTE: High speed calls are highly vulnerable to errors unless the data is protected by error control. The operations described below take place even if one of the modems is not set for error control, thereby prohibiting error control for the call.

DTE rate: 38.4K/19.2K bps
Modem settings: B0, &B1, &H1/&H2/&H3, &M4/&M5, &N0

WARNING: Answering V.32 *bis* modems shift their DTE rate up to 19.2K bps (for 14.4K bps connections) if the calling V.32 *bis* modem dials at 14.4K or 12K bps. The answering V.32 *bis* modem then sends data to its DTE at 19.2K bps. If your DTE is limited to a rate of 9600 bps, disable high-speed modulation by setting Register S34 to a value of 3 (ATS34=3). The calling modem will then shift down to 9600 bps for a V.32, not V.32 *bis*, connection.

1. The answering modem first sends out a 2100 Hz answer tone identifying it as a V.32 or V.32 *bis* modem. If the calling

modem recognizes the tone, the modems connect at the highest possible speed, usually 14.4K bps. (If the calling modem is a V.32 modem, its maximum speed is 9600 bps, and the modems may connect at that rate. But see paragraph 3.)

2. If the calling modem doesn't recognize the answer tone, the answering modem then sends a 2250 Hz answer tone used by 2400, 1200 or 300 bps modems. If the calling modem is operating at one of those rates, the modems connect at the calling modem's rate.

3. If the modems don't connect as in paragraph 1 or 2, the answering V.32 *bis* modem then sends extra V.32 answer tones. If the calling modem is a V.32 modem, the answering V.32 *bis* modem shifts its speed down to 9600 bps and the modems connect at that speed. This extended V.32 handshaking ensures connections with V.32 modems if they did not connect as in paragraph 1.

   It may even be necessary to extend the length of these tones if the modem is to answer older, "dumb" V.32 modems. Register S28 is used to modify the duration of these extra V.32 tones. See S28 in Appendix B.

USRobotics V.32 bis to V.32 bis

1. The modems first negotiate a V.42 error control connection. Speed negotiation is part of the V.42 detection/LAPM sequence. If they fail to make a V.42 connection, these modems follow the procedures described under *V.32 bis*, above.

2. The Receiver of each modem dictates its modem's highest speed, with negotiation beginning at 7200 bps and proceeding upward to the 14.4K bps maximum. This means that your modem's receiver may be operating at a different speed from your modem's transmitter, which operates at the same rate as the remote modem's receiver. In other words, the rate at your modem's Originate frequency may be different from the rate at your modem's Answer frequency.

   Because of this asymmetrical design, one frequency may suffer line hits or other impairments, and fall back to a

slower speed, while the other does not. The result is more efficient line operation. If the impairments are severe, the modems use normal retraining.

Dual Standard Handshaking

Dual Standard modems always connect with each other, either in HST mode or in V.32 *bis* mode. However, we recommend that Dual Standard modems be set to B0 and to &N0, so that they can connect with V.32 *bis*, HST and lower-speed modems, in both Originate and Answer modes.

A Dual Standard modem set to B1 (HST) does not send out any V.32 *bis* or V.32 answer tones, and therefore cannot answer calls in those modes. When it is calling, however, and set to B1, it switches to V.32 *bis* mode if it detects the V.32 *bis*/V.32 answer tone. It attempts to connect at 14.4K bps (V.32 *bis*) or drops to 9600 bps (V.32). The mode shift is for that call only. Similarly, a Dual Standard modem set to B0 will switch to HST mode for that call only if the other modem is operating in HST mode.

ERROR CONTROL AND THROUGHPUT

Overview

Error control is available for calls at 1200 bps and above. It can be disabled, although high speed calls (above 2400 bps) should always be under error control. The operations defined in an error control protocol include the following:

- Establishment of compatibility
- Data frame formatting
- Error detection through Cyclic Redundancy Checking (CRC)
- Retransmission of corrupt data frames

The Courier is set at the factory to &M4, causing it to try for an error control connection and, if that isn't possible, to proceed with the call in Normal mode. The modem first tries for a V.42 connection, then an MNP connection. The following information is based on the Courier's setting of &M4.

CCITT V.42 Handshaking

This international standard includes a two-stage handshaking process:

- A Detection phase that is based on an exchange of predefined characters.
- LAPM (Link Access Procedures for Modems) Negotiation. In this phase, the modems identify their capabilities concerning maximum data block size and the number of outstanding data blocks allowed before an acknowledgment is required.

MNP Handshaking

This protocol is supported by the CCITT V.42 Recommendation. It was originally developed by Microcom, Inc. and is now in the public domain.

MNP is based on special protocol frames. If the remote modem doesn't recognize an MNP Link Request, error control isn't possible. (In HST asymmetrical mode, USRobotics modems use a proprietary scheme similar to MNP.)

Data Compression

If the modems successfully establish a V.42 connection, they also negotiate for V.42 *bis* data compression. If the they successfully establish an MNP connection, they negotiate for MNP5 data compression. The type of compression for a call, if any, is reported in the ATI6 display.

Modems using V.42 *bis* compression negotiate the following options and report them in the ATI6 display.

- Dictionary size, that is, the amount of memory available for compression table entries. (Entries are codes devised for redundant data. The data is packed into shorter data units, called code words, and unpacked by the receiving modem.)

  Possible sizes are as follows. USRobotics modems use 11-bit, or 2048-entry dictionaries, but drop down if the

remote modem uses a 512- or 1024-entry dictionary. The size of the dictionary for a call is reported in the ATI6 display.

Bits	Entries
9	512
10	1024
11	2048

- Maximum string length of each entry. As the dictionary fills, the modem deletes the oldest unused strings.

V.42 *bis* compression is more efficient than MNP5 compression in part because it dynamically deletes unusable strings. In addition, it works better with files that are already compressed. These include .ARC files downloaded from many Bulletin Boards and 8-bit binary files, which seem to the modem to be compressed.

MNP5 compression should not be used with such files because it adds data to them, which lessens throughput. (The additional data is stripped when the file is decompressed by the remote modem.) When transferring such files, it's best to set the modem to &K3: this allows V.42 *bis* compression to work dynamically with the compressed data, but disables MNP5.

Flow Control

Flow control of data from the computer is required under error control for two reasons:

1. The transmitting modem buffers a copy of each frame it transmits to the remote end until it is acknowledged by the receiving modem.
2. If errors are encountered, retransmission activity can cause a steady stream of data from the computer to overflow the buffer.

Throughput Guidelines

The following guidelines should help to make the most of the modem's advanced performance features. In many instances, experimentation and experience will indicate what works best for your applications.

1. Optimal throughput is attained under the following conditions:

   - The communications software allows fixing the DTE rate higher than the link rate, e.g., setting the software to 38.4K or 19.2K bps and setting the modem to &B1.

     If the software automatically switches bit rates to follow the link rate, the modem's DTE rate must be also set to follow the link rate for each call, &B0, and throughput will be limited.

     Installations with specialized software may want to enable a fixed DTE rate for ARQ calls and a variable DTE rate for non-ARQ calls. See the &B2 command in Chapter 4.

   - The call is under data compression.
   - The data is comprised of text files rather than binary files such as .EXE or .COM files. See the table at the end of this appendix.

2. MNP5 compression is disabled for files that are already compressed and 8-bit binary files, that appear to the modem to be already compressed. MNP5 is disabled by setting the modem to &K3.

3. The file transfer is not slowed down by a file-transfer protocol. Many non-text files require a file transfer protocol, but the results vary. For example, certain public domain file transfer protocols have the following effects:

Kermit	Throughput is severely reduced due to Kermit's short block lengths (under 128 bytes) and acknowledgment turn-around time.
Xmodem	Throughput may be reduced if your version uses short block lengths (128 bytes). Some versions user larger blocks (1K blocks). Throughput is also reduced by overhead (error control protocol information).
Ymodem	There is an improvement over Xmodem, due to larger block lengths (1K bytes), but throughput is still reduced by the protocol's error control overhead.

The above protocols further reduce throughput when an error control connection is established. The accuracy of the data is checked twice, by the file transfer protocol and the modem. To avoid redundancy, use the above protocols only for non-ARQ connections, and only at speeds of 2400 bps and below.

For the best throughput performance, we recommend Ymodem-G and ZMODEM as better choices, Ymodem-G being the most efficient. These protocols assume the modems are handling error control: overhead is minimal, with results almost equal to those when there is no file transfer protocol.

Achievable Throughput

The table below indicates the maximum throughput, in characters per second (cps), that can be expected under the following optimal conditions.

- DTE rate set at 38.4K bps; modem set to &B1
- Connection (link) rate of 14.4K bps
- V.42 *bis* compression negotiated for the call, and the default size 11-bit, 2048-entry dictionary
- Straight data (e.g., not already compressed, no file-transfer protocol)
- Transmission from a fast (e.g., 286) computer

	Throughput (cps)	
File Type	**MNP5**	**V.42 *bis***
Assembler or Compiler listing	2880	3840
Text file	2325-2625	3400-3840
Binary file: .EXE	2175-2400	2030-2600
Binary file: .COM	2100-2250	2050-2300
.ARC files (common on BBS's)*	1500-1650	1700
Random binary 8-bit*	1460-1575	1700

* These files are already compressed or appear to the modem to be compressed. Additional MNP5 compression causes throughput lower than what can be expected using MNP without compression. We recommend setting the modem to &K3 when transferring these files, to allow V.42 *bis* but disable MNP5.

Throughput, MNP5 and V.42 *bis*

APPENDIX B. SUMMARIES AND TABLES

CONTENTS

The RS-232 Interface, with Pin Definitions
Front Panel Indicators
DIP Switch Summary
Default Settings
S-Register Summary
ASCII Chart

THE RS-232 INTERFACE

DESCRIPTION

The RS-232 interface is a standard developed by the Electronic Industries Association (EIA). It defines the signals and voltages used when data is exchanged between a computer or terminal and a modem or serial printer. Data is transmitted between the devices via a cable with 25-pin, 9-pin, 8-pin or custom-built connectors.

PIN ASSIGNMENTS

The entire standard covers many more functions than are used in most data communications applications. Pin assignments are factory set in the Courier to match the standard DB-25 assignments in the following table. DB-9 connectors for AT-compatible computers should be wired at the computer end of the cable as shown in the DB-9 column. If you're using an Apple computer, ask your dealer for the correct modem cable for your Apple computer model.

DB-25	DB-9	Circuit	Function	Signal Flow DTE — DCE*
1	—	AA	Chassis Ground	both directions
2	3	BA	Transmitted Data	to DCE
3	2	BB	Received Data	to DTE
4	7	CA	Request to Send	to DCE
5	8	CB	Clear to Send	to DTE
6	6	CC	Data Set Ready	to DTE
7	5	AB	Signal Ground	both directions
8	1	CF	Carrier Detect	to DTE
12	—	SCF	Speed Indicate	to DTE
15	—	DB	Synchronous TX** Timing	to DTE
17	—	DD	Synchronous RX** Timing	to DTE
20	4	CD	Data Terminal Ready	to DCE
22	9	CE	Ring Indicate	to DTE
24	—	DA	Synchronous TX** Timing	to DCE

* DTE indicates the terminal or computer; DCE indicates the modem.
** Indicates Transmitter (TX) or Receiver (RX)

RS-232 Interface Pin Definitions

Minimum Requirements

Some computer/terminal equipment supports only a few of the RS-232 signal functions set in the Courier. The minimum required for the modem to operate are as follows:

Asynchronous Calls

DB-25 Pin	DB-9 Pin	Function
2	3	Transmitted Data
3	2	Received Data
7	5	Signal Ground
20	4	Data Terminal Ready*

* Required only if you have the Data Terminal Ready Override switch OFF (DIP switch 1 UP).

Synchronous Calls

You will need all of the above functions as well as pin 15 for Transmitter timing signals, and pin 17 for Receiver timing signals. You may need pin 24, which is assigned the external timing source, rather than the internal (modem) source assigned to pin 15. See Chapter 7 for more detailed information.

Additional Flow Control Functions

If your computer and software support Clear to Send and you wish to use Transmit Data hardware flow control (&H1), Pin 5 (DB-25) or Pin 8 (DB-9) is required.

If your computer and software support Request to Send and you wish to use Received Data hardware flow control (&R2), Pin 4 (DB-25) or Pin 7 (DB-9) is required.

FOR 38.4K DTE RATE

Your terminal or computer must support the 38.4K rate. Make sure the RS-232 cable is shielded. Cables are normally six feet long, but longer lengths are possible. If you encounter problems with signal degradation, try a shorter cable.

If you decide to build your own cable, use a low-capacitance cable. To further minimize the capacitance, connect only those functions (pins) that your application requires.

FRONT PANEL INDICATORS

Symbol	Meaning	Status
HS	High Speed	All calls above 2400 bps: ON during call progress, after completion of dialing; OFF during HST-mode link negotiations at 2400 bps, then ON during connection. Remains ON after disconnect until next call is originated or answered.
AA	Auto Answer/ Answer	Answer mode only: ON when your modem is in Auto Answer mode, and when answering a call; in HST mode, goes OFF if the channel is reversed and your answering modem transmits at 450 or 300 bps. Also goes OFF when the modem originates a call.
CD	Carrier Detect	ON if DIP switch 6 is UP (factory setting) and the Courier receives a valid data signal (carrier) from a remote modem, indicating that data transmission is possible. Also ON when the CD override is on, DIP switch 6 DOWN.
OH	Off Hook	ON when the Courier takes control of the phone line to establish a data link.
RD	Received Data	Flashes when the modem sends result codes or passes received data bits to the computer or terminal.
SD	Send Data	Flashes when the computer or terminal sends a data bit to the Courier.
TR	Data Terminal Ready	ON if DIP switch 1 is UP (factory setting) and the modem receives a DTR signal from the computer or terminal. Also ON when the DTR override is on, DIP switch 1 DOWN.
MR	Modem Ready/ Test Mode	ON when the Courier is powered on. Flashes when the modems retrain, including online fallback, or while the modem is in Test mode.

Symbol	Meaning	Status
RS	Request to Send	ON if your terminal or software supports RTS and sends the RTS signal. OFF if the Courier is set to &R2 (Received Data hardware flow control) and the computer or terminal lowers RTS.
CS	Clear to Send	ON until the modem lowers CTS when Transmit Data hardware flow control is enabled (&H1, &H3). Always ON during synchronous connections.
ARQ	Error Control	Automatic Repeat Request. ON when the Courier is set to &M4 or &M5 and successfully connects with another modem under error control. Flashes when the Courier retransmits data to the remote modem.
SYN	Synchronous Mode	ON when the modem is set to &M1 and enters synchronous mode.

DIP SWITCH SUMMARY

PURPOSE

The DIP switches, located at the rear of the modem, are for adapting the modem to your equipment and personal requirements. The *Settings Supplement* that comes with the modem indicates the recommended switch settings for many communications software packages. You may also want to experiment and review your software documentation as necessary.

Some users are able to move a single switch with a finger tip. If this doesn't work for you, use a toothpick or other small instrument.

OPERATIONS

The DIP switch settings are power-on defaults, read by the Courier when it is turned on. If changed when the modem is on, switches 2-5, 7 and 9 require the ATZ (software reset) command to initiate the new settings. If you've set switch 8 UP to disable command recognition, and want to return the modem to Smart mode so that it responds to commands, you'll have to power off the modem, reset switch 8 DOWN, and power on the modem again. The remaining (hardware) switches are automatically operative when set UP or DOWN.

Switch	Factory Setting	Function
1	OFF	Data Terminal Ready Operations OFF Normal DTR operations: computer must provide DTR signal for modem to accept commands; dropping DTR terminates a call ON DTR always ON (Override)
2	OFF	Verbal/Numeric Result Codes OFF Verbal (word) results ON Numeric results

Switch	Factory Setting	Function
3	ON	Result Code Display OFF Results suppressed ON Results enabled
4	OFF	Command Mode Local Echo OFF Keyboard commands displayed ON Echo suppressed
5	ON	Auto Answer OFF Modem answers on first ring ON Auto answer disabled
6	OFF	Carrier Detect Operations OFF Courier sends CD signal when it connects with another modem, drops CD on disconnect ON CD always ON (Override)
7	OFF	Auxiliary, DIP Switch 3 ON OFF Result codes in Originate and Answer mode ON Result codes in Answer mode disabled
8	ON	AT Command Set Recognition OFF Command recognition disabled (Dumb Mode) ON Recognition enabled (Smart mode)
9	OFF	Escape Code (+++) Response OFF Modem hangs up, returns to Command mode, sends NO CARRIER result ON Modem maintains connection, returns to Command mode, sends OK result
10	OFF	Power-on and ATZ Reset Software Defaults OFF Load from nonvolatile memory (NVRAM) IB Load factory settings from read only memory (ROM)

continued

Switch	Factory Setting	Function
QUAD SWITCH	OFF	RS-232 Transmit/Receive Pin Assignments OFF Normal assignments; see *Pin Assignments* in Appendix B-1 ON Reversed Transmit/Receive pins *The need to change this switch setting is rare.* Carefully review your computer or terminal documentation before setting this switch DOWN.

DEFAULT SETTINGS

USER-PROGRAMMABLE DEFAULTS

You can create your own default configuration and store it in nonvolatile random access memory (NVRAM) using the &W command described in Chapter 5. As long as DIP switch 10 is UP when you power on the modem, your defaults are loaded into the modem's random access memory (RAM). To view your NVRAM settings at any time, use the ATI5 command.

Tables on the next two pages list the options you can store in NVRAM, including S-Register settings. If DIP switch 10 is DOWN at power-on, the factory settings listed in the table are loaded instead. The first time the modem is turned on, the NVRAM settings are the same as the factory settings.

The following command example substitutes several user-defined defaults for factory settings. The modem also stores the rate, word length and parity it detects from the AT command prefix.

AT X4 &B1 &M5 &H1 M3 &W <Enter>

NVRAM Options	Factory Setting	
Handshake option	B0/B1	V.32 *bis* mode/HST mode
Normal/error control modes	&M4	Normal/ARQ
Data compression	&K1	Auto enable/disable
Transmit data flow control	&H0	Disabled
Rec'd. data hardware flow control	&R1	Ignore RTS
Rec'd. data software flow control	&I0	Disabled
DTE rate select	&B0	Detect from AT command; variable
Link rate select	&N0	Variable
Result code subset	X1	Extended
Error-control response codes	&A1	Enabled
Tone/Pulse dialing	P	Pulse dial
Online local echo	F1	Disabled
Speaker control	M1	ON during dial through connect
Remote Digital Loopback (RDL)	&T5	Deny RDL
Normal/Leased line	&L0	Normal phone line
Data Set Ready override	&S0	Enabled
Synchronous clock source	&X0	Modem transmitter
Break handling	&Y1	Clear buffer, send immediately
Stored telephone number	&Z0-3=0	Blank
Pulse dial make/break ratio	&P0	U.S./Canada
Guard tone	&G0	U.S./Canada
Rack Controller Unit (RCU) Access	%R0	RCU access disabled
Word length*	7	
Parity*	1	Even
DTE rate*	19.2K	

* Detected by the modem from the AT prefix of the &W command that writes your defaults to NVRAM. Set your software to the desired word length, parity, and DTE rate defaults before sending the modem the AT . . . &W string.

NVRAM S-Register Options		Factory Setting
S2	Escape code character	43
S3	Carriage Return character	13
S4	Line Feed character	10
S5	Backspace character	8
S6	Dial wait-time, sec.	2
S7	Carrier wait-time, sec.	60
S8	Dial pause, sec.	2
S9	Carrier Detect time, 1/10th sec.	6
S10	Carrier loss wait-time, 1/10th sec.	7
S11	Touch-Tone duration, spacing, msec.	70
S12	Escape code guard time, 1/50th sec.	50
S13	Bit-mapped functions	0
S15	Bit-mapped functions	0
S19	Inactivity/hang up timer	0
S21	Break length, 1/100th msec.	10
S22	XON character	17
S23	XOFF character	19
S24	Pulsed DSR duration, 2/100th sec.	150
S26	RTS/CTS delay time, 1/100th sec.	0
S27	Bit-mapped functions	0
S28	V.32 handshake time, 1/10th sec.	8
S32	Talk/Data Switch Options	1
S34	Bit-mapped functions	0
S38	Disconnect wait time, sec.	0

* Bit-mapped registers have up to eight functions. See Appendix B-5 in the manual or the briefer summary in the Quick Reference Card.

S-REGISTER SUMMARY

USAGE

The default values are those users typically require. Change the settings with the ATS*r*=*n* command, where *r* is the register and *n* is a decimal value from 0-255:

ATS13=8 <Enter>

The modem does not perform a value-range check. Some values you select may not work with some equipment, and you'll have to readjust the settings.

To display the contents of a register, use ATS*r*? as in this example:

ATS20? <Enter>

Register	Default	Function
S0	See DIP Switch 5	Sets the number of rings on which to answer when in Auto Answer Mode. S0=0 disables Auto Answer, the same as DIP switch 5 DOWN (factory setting). S0=1 enables Auto Answer and the modem answers on the first ring.
S1	0	Counts and stores the number of rings from an incoming call.
S2	43	Stores the ASCII decimal code for the escape code character. Default character is "+". A value of 128-255 disables the escape code.
S3	13	Stores the ASCII decimal code for the Carriage Return character.
S4	10	Stores the ASCII decimal code for the Line Feed character.
S5	8	Stores the ASCII decimal code for the Backspace character. A value of 128-255 disables the Backspace key's delete function.

Register	Default	Function
S6	2	Sets the number of seconds the modem waits before dialing. If set to X2, X4, or X6, the modem ignores this register and dials as soon as it detects a dial tone (fast dials).
S7	60	Sets the number of seconds the modem waits for a carrier. May be set for much longer duration if, for example, the modem is originating an international connection.
S8	2	Sets the duration, in seconds, for the pause (,) option in the Dial command and the pause between command re-executions (> and A> commands).
S9	6	Sets the required duration, in tenths of a second, of the remote modem's carrier signal before recognition by the Courier.
S10	14	Sets the duration, in tenths of a second, that the modem waits after loss of carrier before hanging up. This guard time allows the modem to distinguish between a line hit, or other disturbance that momentarily breaks the connection, from a true disconnect (hanging up) by the remote modem. While we do not recommend connecting the modem to a line with call waiting, if you have call waiting you may wish to adjust this setting upward to prevent the modem from misinterpreting the signal for a second call as a disconnect by the remote modem. A better alternative is to contact your phone company to find out how to temporarily disable call waiting.
S11	70	Sets the duration and spacing, in milliseconds, of dialed Touch-Tones.
S12	50	Sets the duration, in fiftieths of a second, of the guard time for the escape code (+++) sequence.

Register	Default	Function
S13	0	Bit-mapped register. Select the bit(s) you want on and set S13 to the total of the values in the Value column. For example, ATS13=20 enables bit 2 (value = 4) and bit 4 (value = 16).

Bit	Value	Result
0	1	Reset when DTR drops
1	2	Reverse normal Auto Answer operation: on incoming RING, enter Originate Mode and look for Answer tone
2	4	Disable 250 msec. pause before result code display
3	8	On DTR signal, Auto Dial the number stored in NVRAM at position 0
4	16	At power on/reset, Auto Dial number stored in NVRAM at position 0
5	32	Disable HST (used for testing V.32 *bis* in Dual Standard modems)
6	64	Disable MNP Level 3 (used for testing Level 2)
7	128	Custom applications

S14	0	Reserved.

Register	Default	Function
S15	0	Bit-mapped register. To set the register, see the instructions for S13.

Bit	Value	Result
0	1	Disable the modem's extra high-frequency equalization if it causes problems on shorter-link calls—HST modems only
1	2	Disable online fallback
2	4	Disable 450 bps back channel
3	8	Reset non-ARQ mode Transmit buffer from 1.5K bytes to 128*
4	16	Disable MNP Level 4; retransmitting the larger Level 4 data blocks may be a problem if you expect a great number of errors during a call
5	32	Set backspace key to delete
6	64	Some earlier 2400-bps MNP modems, not made by USRobotics or Microcom, were not fully compatible with the MNP protocol. If you have difficulty making a successful 2400-bps MNP connection with a remote MNP modem, it may be because of this incompatibility. Set S15 to 64 and try again to make the connection.
7	128	Custom applications only

* The default 1.5K byte non-ARQ buffer allows data transfer with X- and Ymodem-type file transfer protocols without using flow control.

The 128-byte option allows remote users with slower modems to stop data you're transmitting from scrolling off their screens. When remote users send your computer an XOFF (Ctrl-S) and you stop transmitting, the data in transit from your modem's buffer doesn't exceed the size of their screen.

Register	Default	Function
S16	0	Bit-mapped test register. To set the register, see the instructions for S13. For information on testing, see Appendix F. **Bit Value Result** 0 1 Analog Loopback 1 2 Dial test 2 4 Test pattern 3 8 Remote Digital Loopback 4 16 Reserved 5 32 Reserved 6 64 Reserved
S17	0	Reserved.
S18	0	Test timer for software-initiated loopback testing (&T*n*), disabled when S18 is set to 0. See Appendix F. Used to set the duration of testing, in seconds, before the modem automatically times out and terminates the test.
S19	0	Sets the duration, in minutes, for the Inactivity Timer. The timer activates when there is no data activity on the phone line and at the timeout the modem hangs up. S19=0 disables the timer.
S20	0	Reserved.
S21	10	Sets, in 10-millisecond units, the length of Breaks sent from the modem to the DTE. Applies to ARQ mode only.
S22	17	Stores the ASCII decimal code for the XON character.
S23	19	Stores the ASCII decimal code for the XOFF character.
S24	150	Sets the duration, in 20-millisecond units, between pulsed DSR signals when the modem is set to &S2 or &S3. The default is 3 seconds.

Register	Default	Function
S25	0	Reserved.
S26	1	Sets the duration, in 10-millisecond units, of the delay between RTS and the modem's CTS response in synchronous mode.
S27	0	Bit-mapped register. To set the register, see the instructions for S13.

Bit	Value	Result
0	1	Enable CCITT V.21 modulation at 300 bps for overseas calls. In V.21 mode, the modem answers both Bell 103 and V.21 calls, but only originates V.21 calls.
1	2	Enable unencoded (non-trellis-coded) modulation in V.32 mode; this option is part of the CCITT V.32 recommendation, but is rarely used.
2	4	Disable V.32 modulation; used for testing HST modulation in Dual Standard modems.
3	8	Disable 2100 Hz answer tone to allow two V.42 modems to connect more quickly.
4	16	See below.
5	32	See below.
6	64	Reserved.
7	128	Unusual software incompatibility. Some software may not accept 7200, 12000 and 14400 bps result codes. This setting disables the codes and displays the 9600 code instead. The call's actual rate can be viewed on the ATI6 screen.

continued on following page

Register	Default	Function
		Error control handshaking options: select the total values of bits 4 and 5.

Bit 4	Bit 5	Result
0	0	Complete handshaking sequence: V.42 Detection, LAPM error control, MNP.
16	0	Disable MNP.
0	32	Disable V.42 Detection and LAPM.
16	32	Disable Detection phase, if you know that the remote modem does LAPM, but not the Detection phase.

S28	8	Sets the duration, in tenths of a second, of the extra 3000/600 Hz answer tones sent during V.32 handshaking. Default = 8 (.8 seconds). This gives V.32 modems additional time to connect in V.32 mode before timing out. If there is difficulty answering older, manually operated V.32 modems, for example, modems that require a button to be pushed in order to dial, try lengthening the duration of the extra tones. Setting S28 to zero eliminates the extra tones, resulting in a faster connect time if, for example, the modem is set to use V.21 modulation (300 bps) or V.23 modulation (1200 bps).Sets the duration, in 1/10ths of a second, of the V.32 handshake.

Register	Default	Function
S32	1	Sets the function for the Voice/Data switch. This is not a bit-mapped register. Select the value for the desired function, for example, ATS32=6.

Value	Result
0	Disabled
1	Voice/data, Originate mode
2	Voice/data, Answer mode
3	Redial last number
4	Dial number stored at position 0
5	Auto Answer on/off toggle
6	Reset the modem
7	Initiate Remote Digital Loopback

S34 — Default: 0

Bit-mapped register. See instructions for S13.

Bit	Value	Result
0	1	Disable V.32 *bis*. Used for troubleshooting; USRobotics' Technical Support may require that you disable V.32 *bis* for testing purposes.
1	2	Disable the modem's enhanced, proprietary V.32 *bis* modulation. Used for troubleshooting.
2	4	Disable the faster retrains that occur during proprietary V.32 *bis* modulation. Used for troubleshooting.
3	8	Enable V.23. Required for some British connections.
4	16	Change MR LED to DSR
5	32	Enable MI/MIC; see Appendix E-5.
6	64	Reserved
7	128	Reserved

Register	Default	Function
S38	0	Sets the duration, in seconds, before a forced hang-up and clearing of the Transmit buffer, when DTR drops during an ARQ call. This is provided to allow time for a remote modem to acknowledge receipt of all transmitted data. Default = 0: the modem immediately hangs up when DTR drops. If the modem receives the ATH command, it ignores S38 and immediately hangs up.

ASCII CHART

ASCII CHART											
DEC	HEX	CHAR	DEC	HEX	CHAR	DEC	HEX	CHAR	DEC	HEX	CHAR
00	00	NUL	32	20	SP	64	40	@	96	60	`
01	01	SOH	33	21	!	65	41	A	97	61	a
02	02	STX	34	22	"	66	42	B	98	62	b
03	03	ETX	35	23	#	67	43	C	99	63	c
04	04	EOT	36	24	$	68	44	D	100	64	d
05	05	ENQ	37	25	%	69	45	E	101	65	e
06	06	ACK	38	26	&	70	46	F	102	66	f
07	07	BEL	39	27	'	71	47	G	103	67	g
08	08	BS	40	28	(	72	48	H	104	68	h
09	09	HT	41	29	)	73	49	I	105	69	i
10	0A	LF	42	2A	*	74	4A	J	106	6A	j
11	0B	VT	43	2B	+	75	4B	K	107	6B	k
12	0C	FF	44	2C	,	76	4C	L	108	6C	l
13	0D	CR	45	2D	–	77	4D	M	109	6D	m
14	0E	SO	46	2E	.	78	4E	N	110	6E	n
15	0F	SI	47	2F	/	79	4F	O	111	6F	o
16	10	DLE	48	30	0	80	50	P	112	70	p
17	11	XON	49	31	1	81	51	Q	113	71	q
18	12	DC2	50	32	2	82	52	R	114	72	r
19	13	XOFF	51	33	3	83	53	S	115	73	s
20	14	DC4	52	34	4	84	54	T	116	74	t
21	15	NAK	53	35	5	85	55	U	117	75	u
22	16	SYN	54	36	6	86	56	V	118	76	v
23	17	ETB	55	37	7	87	57	W	119	77	w
24	18	CAN	56	38	8	88	58	X	120	78	x
25	19	EM	57	39	9	89	59	Y	121	79	y
26	1A	SUB	58	3A	:	90	5A	Z	122	7A	z
27	1B	ESC	59	3B	;	91	5B	[	123	7B	{
28	1C	FS	60	3C	<	92	5C	\	124	7C	|
29	1D	GS	61	3D	=	93	5D	]	125	7D	}
30	1E	RS	62	3E	>	94	5E	^	126	7E	~
31	1F	US	63	3F	?	95	5F	_	127	7F	DEL

APPENDIX C. ALPHABETICAL COMMAND SUMMARY

Additional command summaries are on the bottom panel of the modem and in the Quick-Reference Card.

REQUIREMENTS

1. Type commands in either upper or lower case, not a combination.
2. All commands except A/, A> and +++ are preceded by the AT prefix and are executed with the Enter/Carriage Return key (<Enter>).
3. Command length = 40 characters maximum. The modem doesn't count the AT prefix, Carriage Return character, or spaces. It counts but doesn't act on punctuation such as hyphens and parentheses.
4. A missing numeric parameter is assumed to be zero, as in the command to hang up: ATH <Enter> is the equivalent of ATH0 <Enter>.

BASIC COMMAND SET

&	See the Extended Command Summary that follows this Basic Set.
%	See the Percent Command Summary that follows the Extended Command Summary.
A	Force Answer mode when the modem hasn't received an incoming call.
A/	Re-execute the last issued command one time. A/ doesn't take the AT prefix or a Carriage Return.
A>	Re-execute the last issued command continuously until canceled by pressing <any key>. Dial strings are re-executed ten times, after which execution terminates. A> doesn't take the AT prefix or a Carriage Return.
Any key	Terminate current dialing operation resulting from an issued Dial command; terminate Repeat mode (> or A>).

AT — Attention: lets the modem know commands are being issued to it. Must precede all other commands except A/, A> and +++.

B*n* — Handshake options.

- B0 — a) V.32 *bis* modulation (includes V.32 answer tones). Courier V.32 *bis*: Default. Courier HST Dual Standard: Required to answer V.32 *bis* calls. To call V.32 *bis* modems, may be set to B0 or B1. HST modulation remains enabled. Courier HST: See next paragraph. HST modulation remains enabled.

  b) CCITT V.25 answer sequence. Required for all Courier modems answering overseas calls at 1200 bps and above.

- B1 — a) HST modulation (no V.32 *bis* answer tones). Courier HST: Default. Courier HST Dual Standard: Default. Also calls, but does not answer, V.32 *bis* modems. Courier V.32 *bis*: Calls, but does not answer, V.32 *bis* modems.

  b) Bell answer tone, United States and Canada.

C*n* — Transmitter enabled/disabled.

- C0 — Transmitter disabled; receive-only condition.
- C1 — Transmitter enabled (Default).

D — Dial the number that follows and enter Originate mode. Optional parameters:

- P — Pulse dial (Default).
- T — Touch-Tone dial.
- , — (Comma) Pause for 2 seconds.
- ; — Return to Command mode after dialing.
- " — Dial the letters that follow.
- ! — Transfer call (flash switch-hook).
- W — Wait for second dial tone (with X3 or higher).
- @ — Wait for an answer (with X3 or higher).
- R — Reverse frequencies.
- DL — Dial the last-dialed number.

DS*n* — Dial the phone number stored in NVRAM at position *n* (*n* = 0-3).

E*n* Command mode local echo (display) of keyboard commands ON/OFF. DIP switch 4 is factory set to Command mode echo ON.

- E0 Local echo OFF.
- E1 Local echo ON.

F*n* Online local echo of transmitted data ON/OFF. Sometimes referred to as the Duplex setting.

- F0 Local echo ON. Sometimes called Half Duplex. Modem sends a copy to your screen of data it sends to the remote system.
- F1 Local echo OFF (Default). Sometimes called Full Duplex. Receiving system may send a remote echo of data it receives.

H*n* On/off hook control.

- H0 Hang up (go on hook).
- H1 Go off hook.

I*n* Inquiry.

- I0 Display product code.
- I1 Display results of ROM checksum.
- I2 Display results of RAM test.
- I3 Display call duration or real time (see K*n*).
- I4 Display current modem settings.
- I5 Display nonvolatile random access memory (NVRAM) settings.
- I6 Display link diagnostics.
- I7 Display product configuration.

K*n* Modem clock operation: Call-duration or Real-time mode.

- K0 Return call duration at ATI3 (Default).
- K1 Return actual time at ATI3. Clock is set using ATI3=HH:MM:SS K1.

M*n* Monitor (speaker) control.

- M0 Speaker always OFF.
- M1 Speaker ON until carrier is established (Default).
- M2 Speaker always ON.
- M3 Speaker ON after last digit dialed and until carrier is established.

O Return online after command execution.

- O0 Return online (normal).
- O1 Return online and retrain. Use if there were errors in a non-ARQ data transfer.
- O2 Return online, initiate a 2400 bps speed shift, and drop down to 1200 bps. Applies only to calls at 2400 bps, and may be used if the remote modem is a V.22 *bis* modem *and* ATO1 didn't work. Used mainly for testing purposes.

P Pulse dial (Default).

Q*n* Quiet mode: result codes displayed/suppressed. DIP switch 3 is factory set for result code display.

- Q0 Result codes displayed.
- Q1 Result codes suppressed (quiet).
- Q2 Result codes suppressed in Answer mode.

S*r*=*n* Set S-Register value: *r* is any S-Register; *n* must be a decimal number between 0 and 255.

S*r*.*b* = *n* Alternative command for setting bit-mapped registers: *r* is the bit-mapped register; .*b* is the bit; *n* is 0 (off) or 1 (on).

S*r*? Query contents of register *r*.

T Tone dial.

V*n* Return result codes in words or numbers (Verbal/Numeric mode). DIP switch 2 is factory set for verbal result codes.

- V0 Numeric mode.
- V1 Verbal mode.

X*n* Result code set options. Use the following table (Default = X1, Extended set, codes 0-5, 10, 13, 18).

	Setting							
Result Codes	**X0**	**X1**	**X2**	**X3**	**X4**	**X5**	**X6**	**X7**
0/OK	•	•	•	•	•	•	•	•
1/CONNECT	•	•	•	•	•	•	•	•
2/RING	•	•	•	•	•	•	•	•
3/NO CARRIER	•	•	•	•	•	•	•	•
4/ERROR	•	•	•	•	•	•	•	•
5/CONNECT 1200		•	•	•	•	•	•	•
6/NO DIAL TONE			•		•		•	•
7/BUSY				•	•	•	•	•
8/NO ANSWER				•	•	•	•	•
9/RESERVED								
10/CONNECT 2400		•	•	•	•	•	•	•
11/RINGING						•	•	•
12/VOICE						•	•	
13/CONNECT 9600		•	•	•	•	•	•	•
18/CONNECT 4800		•	•	•	•	•	•	•
20/CONNECT 7200		•	•	•	•	•	•	•
21/CONNECT 12000		•	•	•	•	•	•	•
25/CONNECT 14400		•	•	•	•	•	•	•
Functions								
Adaptive Dialing			•	•	•	•	•	•
Wait for 2nd Dial Tone (W)				•	•	•	•	•
Wait for Answer (@)				•	•	•	•	•
Fast Dial			•		•		•	•

NOTE: Use &A0 or &A1 to disable/enable the following ARQ result codes. The default is &A1, ARQ codes (messages 14 to 19) enabled.

14/CONNECT /ARQ (only when modem is set to X0)
15/CONNECT 1200/ARQ
16/CONNECT 2400/ARQ
17/CONNECT 9600/ARQ
19/CONNECT 4800/ARQ

Use &A2 to add HST or V.32 modulation indicators, as well as ARQ and non-ARQ status, to the result codes.

Use &A3 to add error control protocol indicators (LAPM, HST, MNP, SYNC, or NONE) and data compression type (V42BIS or MNP5) to the result codes.

Z	Software reset to NVRAM settings if DIP switch 10 is UP, to factory settings if DIP switch 10 is DOWN. Also initiates new settings of DIP switches 2-5, 7 and 9.
+++	Escape code, preceded and followed by a guard time of at least one second of no data transmission. The modem responds to +++ by returning to Command mode and doing the following: DIP switch 9 UP (OFF, Factory setting): Hangs up and sends NO CARRIER result code DIP switch 9 DOWN (ON): Retains phone line connection and sends OK result code
>	Repeat the command continuously until canceled by pressing <any key>. If used in a Dial string, automated redialing terminates after ten attempts.
/	(Slash) Pause 125 milliseconds.
$	Help Basic command summary request.
&$	Help Extended command summary request.
D$	Help Dial command summary request.
S$	Help S-Register summary request.
<Ctrl>-S	Stop/restart display of Help screens.
<Ctrl>-C or <Ctrl>-K	Cancel display of Help screens.

AMPERSAND COMMAND SET

&A*n*	Enable/disable additional result code subsets. See the X command in the previous section. &A0 ARQ result codes disabled. &A1 ARQ result codes enabled. Default. &A2 Additional HST or V32 modulation indicator. &A3 Additional error control indicator (LAPM, HST, MNP, SYNC, or NONE) and data compression type (V42BIS or MNP5).

&B*n* Data Rate, terminal-to-modem (DTE/DCE).

- &B0 DTE/DCE rate switches to follow connection rate (Default).
- &B1 DTE/DCE rate remains fixed at the DTE setting. Allowable rates are 38.4K, 19.2K, 9600, 4800, 2400, 1200, 300 bps.
- &B2 Shift to the user-defined fixed, higher DTE rate for ARQ calls, follow the connection rate for non-ARQ calls. Answer mode only.

&C*n* Carrier Detect (CD) signal, modem-to-DTE. DIP switch 6 is factory set so that the modem controls CD and the override is disabled.

- &C0 CD override (CD always ON).
- &C1 Modem sends CD signal when it connects with another modem, drops CD on disconnect.

&D*n* Data Terminal Ready (DTR) signal, DTE-to-modem. DIP switch 1 is factory set for normal DTR operations and the override is disabled.

- &D0 DTR override (DTR always ON).
- &D1 Reserved.
- &D2 Terminal must send DTR for modem to accept commands. Dropping DTR terminates a call.

&F Load factory (ROM) settings into random access memory (RAM).

&G*n* Guard tone as part of answer sequence, for 2400/1200 bps calls from overseas.

- &G0 No guard tone, U.S., Canada (Default).
- &G1 550 Hz guard tone, some European countries.
- &G2 1800 Hz guard tone, U.K., some Commonwealth countries. Requires B0 setting.

&H*n* Transmit Data flow control.

- &H0 Flow control disabled (Default).
- &H1 Hardware (Clear to Send) flow control.
- &H2 Software (XON/XOFF) flow control.
- &H3 Hardware and software flow control.

&I*n* Received Data software flow control.

- &I0 Flow control disabled (Default).
- &I1 XON/XOFF to local modem and remote computer.
- &I2 XON/XOFF to local modem only.
- &I3 Host mode, Hewlett Packard protocol.
- &I4 Terminal mode, Hewlett Packard protocol.
- &I5 Same as &I2 in ARQ mode. In non-ARQ mode, XON/XOFF to remote modem for link flow control.

&K*n* Data compression.

- &K0 Disabled.
- &K1 Auto enable/disable (Default). Disabled if modem is set to &B0 and DTE rate switches to match link rate.
- &K2 Enabled regardless of &B*n* setting.
- &K3 Selective data compression—MNP Level 5 disabled.

&L*n* Normal/Leased phone line.

- &L0 Normal phone line (Default).
- &L1 Leased line; enables the modem to reconnect if disconnected.

&M*n* Error Control (ARQ) and Synchronous Operation.

- &M0 Normal asynchronous mode, error control disabled.
- &M1 Synchronous mode, error control disabled.
- &M2 Reserved.
- &M3 Reserved.
- &M4 Normal/ARQ asynchronous mode (Default). Normal connection if ARQ connection cannot be made.

&M5 ARQ asynchronous mode. Modem hangs up if ARQ connection cannot be made.

&N*n* Link Rate (DCE/DCE) variable or fixed. With fixed link rate, modem hangs up if called or calling modem is operating at a different rate.

&N0 Variable link operations (Default). Modem negotiates highest possible link rate with remote modem.

&N1 300 bps.

&N2 1200 bps.

&N3 2400 bps.

&N4 4800 bps.

&N5 7200 bps.

&N6 9600 bps.

&N7 12K bps

&N8 14.4K bps

&P*n* Pulse dialing make/break ratio.

&P0 U.S./Canada make/break ratio (Default).

&P1 U.K./some Commonwealth countries make/break ratio.

&R*n* Received Data hardware (RTS) flow control.

&R0 Delay before modem responds to DTE's RTS signal with CTS signal. Delay is set in Register S26.

&R1 Ignore RTS (Default).

&R2 Received data sent to DTE only when RTS is high; used only if DTE supports RTS signaling.

&S*n* Data Set Ready (DSR) operations.

&S0 DSR override, always ON (Default).

&S1 Modem sends DTE a DSR signal when it senses a modem tone on the phone line.

&S2 On loss of carrier, modem sends DTE a pulsed DSR signal with Clear to Send (CTS) following Carrier Detect (CD).

&S3 This is the same as &S2, but without CTS following CD.

&T*n* Modem testing.

- &T0 End test.
- &T1 Initiate Analog Loopback (AL) testing.
- &T2 Reserved.
- &T3 Initiate Local Digital Loopback (LDL) testing.
- &T4 Grant Remote Digital Loopback (RDL).
- &T5 Prohibit RDL.
- &T6 Initiate RDL testing.
- &T7 Initiate RDL with self-test and error correction.
- &T8 Initiate AL with self-test and error correction.

&W Write current settings to nonvolatile random access memory (NVRAM).

&X*n* Synchronous Timing Source. This specifies whether the modem or DTE generates the timing signals for the Transmit clock during a synchronous call.

- &X0 Modem's Transmit clock is the source (Default).
- &X1 DTE is the source.
- &X2 Modem's Receiver clock is the source; valid only in V.32 *bis* mode or for 2400/1200-bps connections in HST mode.

&Y*n* Break handling. Destructive Breaks clear the buffer; expedited Breaks are sent immediately to the remote system. Under data compression, destructive Breaks cause both modems to reset their compression tables.

- &Y0 Destructive, don't send Break.
- &Y1 Destructive, expedited (Default).
- &Y2 Nondestructive, expedited.
- &Y3 Nondestructive, unexpedited; modem sends Break in sequence with data received from DTE.

&Z*n* = *s* Write the following Dial string (*s*) to NVRAM at position *n* (*n* = 0-3).

&Z*n*? Display the phone number stored in NVRAM at position *n* (*n* = 0-3).

PERCENT COMMAND SET

%R*n* Rack Controller Unit (RCU) access. For use with USRobotics Total Control Modem Management Systems.

- %R0 Normal operations, RCU access disabled (Default).
- %R1 RCU access enabled.

%T Touch-Tone Recognition mode enabled.

APPENDIX D. PROBLEMS AND SOLUTIONS

You may occasionally encounter one of the problems listed here. They are divided into two categories: before and during the exchange of user information over the data link.

Before Establishment of the Data Link

Your modem . . .

Doesn't answer the phone or go off hook to dial a number

Review the Settings Supplement that came with the modem or your communications software manual to see what Data Terminal Ready (DTR) operations your software requires. Then check to see if DIP switch 1 is set correctly. Also, check to make sure your terminal or computer is sending a DTR signal via the RS-232 interface.

Doesn't respond OK when you type AT <Enter>

1. Make sure you're typing in either upper case or lower case letters, not a combination, and that you press the Enter key.
2. If you're using a computer, make sure it is in Terminal Mode. This is a communications software function. See *Testing the Modem* in Chapter 2.
3. Check to see that your terminal or software is set to the correct bit rate and word length (7 bits with or without a parity bit, or 8 bits and no parity). If you're using a computer, make sure your software is set to the correct communications port.
4. Check that DIP switch 8 is DOWN, for command set recognition. If the switch is UP, power off the modem, set the switch DOWN, and power on the modem again. Try typing AT <Enter> again.
5. Check that DIP switch 3 is DOWN, for result code display, and that DIP switch 2 is UP, for verbal result codes. If not, change the switch(es) and type ATZ <Enter>. Or type whichever of these commands is needed:

ATQ0 <Enter> (to enable the message)
ATV1 <Enter> (to display a verbal message)

6. Review the Settings Supplement that came with the modem or your communications software manual to see what Carrier Detect (CD) operations your software requires. Then check to see if DIP switch 6 is set correctly.

7. A rare condition is that your terminal or computer reverses the send/receive functions at the RS-232 interface. See Appendix B-1, Appendix B-3, Quad switch, and your equipment documentation.

Displays double characters

Both your modem's and software's local echo are characters on. You can turn your software's local echo off. Or turn the modem's echo off by either resetting DIP switch 4 and sending the modem the ATZ command, or by sending the modem the ATE0 command.

Your computer . . .

Reacts as though a data link has been established, but no call has been received

DIP switch 6 is set DOWN at the factory for Carrier Detect (CD) override, but your system may require that the override be turned OFF.

Review your terminal's manual, the Settings Supplement that came with the modem or your communications software manual to see what CD operations are required. Then check to see if DIP switch 6 is set correctly.

When the modem is in Answer mode, acts if a Carriage Return has been entered, but nothing has been typed at the keyboard

Your software may be misreading signals from the modem as it automatically sends a Carriage Return and a Line Feed before and after the RING and CONNECT messages. Sending the Quiet Mode command, ATQ1 <Enter>, should solve the problem.

Both modems . . .

Exchange carrier signals, but fail to establish a communications link

1. Asynchronous operations: Check to make sure the proper bit rate, word length, parity and number of Stop bits have been selected. Synchronous operations: review the link instructions in Chapter 7. If you've set the modem to the correct configuration, the problem may be with the synchronous adapter or with the system you're trying to call.
2. Check to see that your modem is at the correct Bn setting to connect with either an HST modem (B1 setting) or V.32 modem (B0 setting). Type ATI4 for a display of the Courier's current settings and, if necessary, send the modem the correct setting.
3. If your modem is attempting to answer a V.32 call, you may need to lengthen the extra V.32 answer tones. See S28 in Appendix B-5.
4. Make sure the modem at the other end of the line is USR-HST compatible at 14.4K or 9600 bps, V.32-compatible at 9600 bps, V.22 *bis*-compatible at 2400 bps, Bell 212A-compatible at 1200 bps, or Bell 103-compatible at 300 bps. These are the common signaling standards for full duplex dial-up network transmission in the U.S.
5. If none of the above corrects the problem, it's likely that the quality of the phone connection is poor and that the other modem is missing the signals your modem is transmitting. The variable quality of phone line connections may be due to any number of conditions in the phone service's equipment or the current environment. Try several calls, and if you still can't get through, try calling another modem. If the second modem accepts your call, the problem may lie with the modem you first tried to call.

During Data Transfer

Your screen displays . . .

Only brackets

Check to make sure that both modems are set to the same bit rate, word length, parity and number of Stop bits. If the settings

are correct, the problem may be with the phone line. Try the following measures:

1. Try placing the call again. The phone company routes even local calls differently each time you call.
2. Try calling a different modem to see if the problem persists. The problem may be with the modem you first tried to call.

Random or garbage characters

Check to make sure that both modems are set to the same bit rate, word length, parity, and number of Stop bits.

If the modem is set to a fixed DTE rate (&B1) and your software is fixed at 19.2K or 38.4K bps, the reason may be one of the following:

1. Your computer may not support the high rate. If this is the case, fix your software rate at 9600 bps and disable high-speed V.32 *bis* modulation: ATS34=3 or ATS34 .0=1 .1=1.
2. If you use memory-resident programs (TSRs), they may be interfering. Try disabling them before you run your communications software. The same is true of disk-caching programs.
3. Check to see that your software and the modem are set for the same kind of flow control, either hardware or software. Some communications programs also require that you disable the kind you are not using.

Double characters

Your modem's online local echo is on and the remote modem is also echoing. The only way to correct this is to bring the modem back to Command mode (wait one second without transmitting data, type +++, wait another second). Then type the command to turn off your online echo (ATF1 <Enter>).

If DIP switch 9 is UP (factory setting), the modem hangs up when it returns to Command mode, and you'll have to call again. If DIP switch 9 is DOWN, the modem maintains its connection. You can return it back online by typing ATO <Enter>.

IF YOU STILL HAVE PROBLEMS

The problems described above are by far the most common ones that users encounter. If the suggestions we've given don't clear up your difficulties, try the following:

1. Review the manual carefully to see if you've missed something.
2. Call or visit your dealer. Chances are your dealer will be able to give you the assistance you need. This is much more efficient and time-saving than returning the modem to USRobotics.
3. If your dealer can't clear up your difficulties, call the USRobotics Technical Support Department at 800/982-5151. Our Service Representatives will be happy to give you assistance over the phone Monday through Friday from 8:30 a.m. to 5 p.m. (Central Time Zone).
4. If necessary, the Service Representative you talk to may give you a Return Materials Authorization (RMA) number. Modems without an RMA number will not be accepted.
5. If you do return the modem to us, please use the following procedures.
   a. Ship the unit, postage paid, in its original container. If the original container is not available, pack the modem carefully in a strong box of corrugated cardboard with plenty of packing material.
   b. Be sure to include your RMA number inside the package, along with your name and address. Put your return address and your RMA number on the shipping label as well.
   c. Ship the well-packed modem to the following address.

      Technical Support Department
      U.S. Robotics, Inc.
      8100 North McCormick Boulevard
      Skokie, Illinois 60076

   d. Please note that USRobotics will not accept packages sent COD, so be sure to send the modem postage paid.
   e. USRobotics will repair your modem and return it to you via United Parcel Service.

APPENDIX E. ADDITIONAL OPERATIONS

CONTENTS

Voice/Data
High Speed/Low Speed Protocol
Dedicated and Leased Line Operations
Hewlett Packard 3000 Installations
MI/MIC Operations

VOICE/DATA

The voice/data switch is located on the modem's front panel. While the switch's primary function is to toggle back and forth between voice and data communications, this new feature also allows you to perform other functions at the touch of a switch. Set Register S32 for any one of the functions, and change that function any time you wish.

NOTE: Use the voice/data switch when the modem is in Command mode (offline). If you press the switch while the modem is online, the modem hangs up and returns a NO CARRIER result code.

VOICE/DATA OPERATIONS—S32=1, S32=2 OR AT COMMANDS

When you assemble the Courier, you have the option of plugging your phone into the second modular jack of the modem so it's available for voice calls. You can also switch between the phone and modem during a call.

Users of Courier modems have always been able to phone and make arrangements with another user before turning control of the call over to the modems. However, it was difficult to switch from data to voice. Now, if the remote modem has handset exclusion, you can change from voice to data and back again, with or without issuing a command.

Handset exclusion means that if the modem is using the phone line, your phone (handset) is automatically disconnected. However, if you keep the handset off hook, once you hang up the modem the handset takes over the phone line and you can use voice communications again. If the remote user does not have handset exclusion, you may not be able to switch back to voice mode successfully once you have switched to data mode.

The following instructions begin with toggling voice/data communications with the switch. These are followed by instructions for doing the same thing with AT commands. Keep in mind that you can use the switch and, if the remote user does not have a switch, he or she can follow the instructions for using the appropriate AT command.

Voice/Data Switch—S32=1, S32=2

1. Phone the other user to establish the bit rate, parity, word length and number of Stop bits the other person's modem accepts. (Both modems should be offline, in Command mode.)

   You and the other user must also agree on which modem will go off hook in Originate mode and which in Answer mode. The Courier is factory set to go off hook in Originate mode, S32=1. The Answer modem should have S32 set to 2.

   NOTE: Either party's device can be the originate or answer modem: it doesn't matter who made the phone call. But one modem must first enter Originate mode and the other then enter Answer mode.

2. Without hanging up the phone, press the voice/data switch.

   (If S32 is set to 2, Answer mode, press the voice/data switch immediately *after* the remote user forces the remote modem off hook in Originate mode.)

3. The other party should force the remote modem off hook in Answer mode by pressing the switch.

   (If yours is the Answer modem (S32=2), the other party should press the voice/data switch immediately *before* you do so.)

4. If the remote modem has handset exclusion, the remote user should also keep the phone off hook in order to switch back to voice later. If the remote modem doesn't have handset exclusion, you can try to switch back to voice later. Or, you both can hang up your phones as soon as the modems go off hook.

Software Commands—ATD, ATA

If your voice/data switch is set for a function other than voice/data operations and you don't wish to change it, use commands.

1. Call the other user to establish the bit rate, parity, word length and number of Stop bits the other person's modem accepts. Determine which modem will originate and which will answer.

2. If you are to originate the connection, type the following command:

   ATD <Enter>

   NOTE: Be sure the modem is not set to X2, X4, X6 or X7, or it will return the NO DIAL TONE result code and hang up.

3. The other party must then have the remote modem go off hook in Answer mode. The following command is used to do this:

   ATA <Enter>

4. If the remote modem also has handset exclusion, leave both phones off hook in case you wish to switch back again to voice after your data transfer. If the remote modem doesn't have handset exclusion, switching back to voice may not be successful. If you don't want to switch back to voice later, hang up both phones as soon as the modems go off hook.

ALLOWABLE VOICE/DATA SWITCH FUNCTIONS

Use Register S32 to set the voice/data switch for the function you desire. S32 is not bit-mapped. The value for each option is absolute and exclusive. The default is S32=1—the switch forces the modem off hook in Originate mode. You may set the switch to any one of the following functions:

S32 Value	Voice/Data Switch Function	Related Command
0	Disabled	—
1	Voice/Data–Originate Mode (Default)	ATD (Chapter 7, Appendix C)
2	Voice/Data–Answer Mode	ATA (Appendix C)
3	Redial Last Number	ATDL (Chapter 6)
4	Dial Number Stored at position 0	ATDS0 (Chapter 6)
5	Auto Answer On/Off Toggle	ATS0=0 or 1 (Chapter 6)
6	Reset Modem	ATZ (Chapter 5)
7	Initiate Remote Digital Loopback	AT&T6, S16=8 (Appendix F)

HIGH SPEED/LOW SPEED PROTOCOL

OVERVIEW

This appendix explains how an answering Courier modem switches its link rate to match the rate of a calling modem. It may be of help also to those users who want to try programming their computers to switch bit rates to match the Courier's connection rate. The material here applies only when the modem is set for variable rates at both the DTE (computer) and link interfaces, &B0 and &N0, respectively.

In both Originate and Answer modes, if the link rate is set to &N0, the Courier negotiates with the remote modem to connect at the highest possible rate. In addition, if the modem is set to Extended or Advanced result codes (X1 or higher) it signals the DTE with one of the following result codes or the optional result codes selected with the &A*n* command.

CONNECT	(300 bps)
CONNECT 1200	(1200 bps)
CONNECT 2400	(2400 bps)
CONNECT 4800	(4800 bps)
CONNECT 9600	(9600 bps)

The modem sends the result code at its previous rate. Then it switches to the new connection rate.

If your computer doesn't switch rates and you want to program it to do so, use the example on the next page as a guide. It demonstrates the occurrence of the CONNECT codes in the connection sequence, so that recognition of the codes can be used to switch the computer. The example uses a sequence of incoming calls, but the codes apply to Originate mode connections as well.

The example assumes the following settings:

Software: Initially 9600 or 19.2K, or 38.4K bps, allowing the following range of link rates: 9600/4800/2400/1200/300/110 bps

Modem: X1 or higher (rate-specific CONNECT codes) &B0 (variable DTE rate) &N0 (variable link rate)

NOTE: The HST-mode link rate of 14.4K bps is not included because this link rate requires a fixed DTE rate of 19.2K or 38.4K bps, that is, a modem setting of &B1.

Example

Action	Modem Response	DTE/DCE Rate
1. Power on.		9600
2. 300-bps call comes in.	RING	9600
	CONNECT	9600
3. Data link is established. Data transfer takes place.	300	
4. Data session is over. Call is ended; loss of carrier.	NO CARRIER	300
5. 2400-bps call comes in.	RING	300
	CONNECT 2400	300
6. Data link is established. Data transfer takes place.		2400
7. Data session is over. Call is ended; loss of carrier.	NO CARRIER	2400
8. 9600-bps call comes in.	RING	2400
	CONNECT 9600	2400
9. Data link is established. Data transfer takes place.	9600	
10. Data session is over. Call is ended; loss of carrier.	NO CARRIER	9600

Explanation

1. The modem is powered on and is operating at 9600 bps. If the software is then set to 19.2K bps and an AT command sent, the DTE/DCE rate would be 19.2K bps.
2. A 300-bps modem calls. The Courier senses the incoming signal and sends the messages RING and CONNECT to the computer. These messages are sent at 9600 (or 19.2K) bps, the current rate.
3. Since the Courier responds CONNECT, rather than CONNECT 1200, 2400, or 9600, the computer switches to 300 bps. The modem automatically shifts to 300 bps to accept the data from the incoming call.
4. The 300-bps data session is terminated; the modem sends the computer the message NO CARRIER at 300 bps.
5. A 2400-bps call comes in. The modem responds RING and CONNECT 2400. These message are sent at the current bit rate of 300 bps.
6. The computer, receiving the CONNECT 2400 message, adjusts accordingly to the higher bit rate. The modem also shifts to 2400 bps.
7. The 2400-bps data session is terminated; the modem sends the computer the message NO CARRIER at 2400 bps.
8. A 9600-bps call comes in. The modem responds RING and CONNECT 9600. These messages are sent to the computer at the current bit rate of 2400 bps.
9. The computer, receiving the CONNECT 9600 message, adjusts accordingly to the higher bit rate. The modem also shifts to 9600 bps.
10. The 9600-bps data session is terminated; the modem sends the message NO CARRIER at 9600 bps.

Keep in mind that whether or not your computer adjusts to these rate changes, the Courier automatically shifts connection rates if it is set to &N0.

DEDICATED AND LEASED LINE OPERATIONS

The following operations apply in installations where the modem's phone line is not part of a public-access switched telephone network. Instead, the modem is connected to a special user-installed telephone line or a line that is leased from the telephone company. These lines are often referred to as *dedicated* (to a pair of modems) or *private* lines.

In both types of installation there is a continuous point-to-point connection between two modems. No dialing of phone numbers is required. The modems may be in either Smart or Dumb mode (determined by the position of DIP switch 8).

The User-Installed or Leased Telephone Line

User-installed lines are most commonly 2-wire lines, similar to the 2-wire lines that connect residential phones to the public switched network.

If you are leasing a line from the telephone company, request a 2-wire line, the type of line the modem is designed to work with. If the telephone company only makes a 4-wire line available, you'll need a 4-wire to 2-wire converter at each end of the connection. If the phone company does not install the converters, you will have to supply them.

For optimal operations, we recommend that the physical length of these lines not exceed 5 miles.

Setting the Modem

If the Courier is set to &L1, as described in what follows, and the remote AT-compatible modem has a comparable setting, they automatically connect when they are powered on. They also reconnect, without any operator intervention, if a disturbance on the line is severe enough to break the connection.

Set the modem as follows:

1. Set your terminal or communications software to the rate at which you want the modems to communicate. For example, use a terminal/software setting of 19.2K bps and, if both modems have the capability, they will connect at 14.4K bps. The following instructions assume that you are familiar with

the guidelines on using the &B and &H commands (Chapter 3 or, in more detail, Chapter 4) and the &W command (Chapter 5).

2. Send the modem the following command:

   AT &B1 &S2 &H1 &L1 &W <Enter>

   &B1 fixes the modem's computer interface rate at 19.2K bps. &S2 causes the modem to send a Clear to Send (CTS) signal *only* after it sends the Carrier Detect (CD) signal, that is, only after it connects with the remote modem. (See the note that follows.) &H1 enables hardware (CTS) flow control.

   &L1 forces the modems off hook at power on and enables them to re-establish the connection should it be broken. &W writes the settings to nonvolatile memory (NVRAM) as power-on defaults.

   NOTE: We recommend using the &S2 setting, to delay CTS until after the connection is made, as a precaution. If the modems are in the process of connecting or reconnecting, the Courier interprets any keyboard data entry, including an accidental key stroke, as a *key-press abort*, and hangs up. Delaying CTS until after carrier detection prevents this from happening, for example, if you are typing data to the remote modem when the modems momentarily disconnect and begin to reconnect. However, you have to set the modem for hardware flow control, &H1.

   If your software or machine does not support Clear to Send (CTS), don't inlcude &S2 and &H1 in the command string suggested above. Follow the Transmit Data flow control (&H) guidelines in Chapter 4. But keep in mind that if the modems fail to connect or reconnect, the reason could be a key-press abort.

3. Set the modem to load NVRAM settings at power-on, DIP switch 10 UP. It does not matter if the modem is in Dumb or Smart mode (DIP switch 8).

4. Decide which modem is to be the calling modem and which the answering modem. Set the answering modem to Auto Answer, DIP switch 5 UP, and the calling modem to Auto Answer suppressed, DIP switch 5 DOWN.

5. Power off and power on the modems. This initiates the new DIP switch settings and loads the power-on defaults, including &L1. The modems go off hook and establish the connection.

NOTE: If the modems cannot restore the connection and you could not set the modem to &S2, the reason could be a key-press abort. If the problem persists, however, you may need to call your telephone company to have them check your line.

HEWLETT PACKARD INSTALLATIONS

During error control connections, the Courier recognizes the ASCII ENQ/ACK characters exchanged between many Hewlett Packard host computers and their terminals. The HP host sends the terminal an ENQ character at predefined intervals, and sends no more data until the terminal responds with an ACK character.

Courier modems manage this ENQ/ACK protocol so that communication is speeded up, thereby enabling HP terminals to achieve high speeds on dial-up lines. Special flow control settings, using the &I command, are required for HP users. These settings apply to ARQ and non-ARQ connections and to Courier modems set to either B0 or B1. Disregard other Courier flow control commands.

Set the Courier to Host mode if it is attached to the host computer, or to Terminal mode if it is attached to a terminal, as follows:

Host mode **AT&I3 <Enter>**

Terminal mode **AT&I4 <Enter>**

MI/MIC OPERATIONS

DESCRIPTION

Mode Indicate/Mode Indicate Common (MI/MIC) closure is required by some installations whose existing hardware does the dialing. The modems do not Auto Dial.

In these situations, the modem must be forced off hook in Originate mode. This is done by shorting (closing) two of the pins (not Tip and Ring) in the phone connector. The modem is then ready to go online and accept data when it connects with the number dialed by the system equipment.

Courier modems are shipped with MI/MIC disabled, that is, for normal use. To set the modems for MI/MIC closure, enable bit 5 of Register S34: ATS34=32 or ATS34 .5=1. We recommend that you write that setting to NVRAM as a power-on default.

Once you've set Register S34, have the system force the modem off hook by closing the MI/MIC leads in the phone line connector. The modem's OH (Off Hook) status light, or LED, goes on when the modem goes off hook.

TROUBLESHOOTING

You may find that the modem does not respond to MI/MIC closure, which you can monitor by observing the LED. Or the modem may fail to go back on hook when the DTE drops the Data Terminal Ready (DTR) signal. The probable reason for either of these conditions is that your phone equipment reverses MI/MIC polarity.

It's possible to solve this problem by reversing the modem's MI/MIC wiring. You'll have to dismantle the modem case and reset two switches on the printed circuit board, as follows.

1. Power off the modem and disconnect all of its cables.
2. Turn the modem upside down. Remove the two square vinyl feet near the back of the case, on either side of the bottom label's DIP switch diagram. Be careful to put the vinyl feet aside, upside down, where they won't become stuck to another object.

3. Remove the two Phillips screws. Raise the back end of the case bottom until it is at about a 60° angle; lift it away from inside the front of the modem. Put the case bottom aside.

4. Locate the Voice/Data switch and Volume Control at the front of the modem. Lift up and remove the modem (printed circuit board), carefully easing the Voice/Data switch out of its opening in the front panel.

5. Turn the modem rightside up and locate jumper switches J6 and J8, near the power-adaptor socket. Use Figure E-1 as a guide.

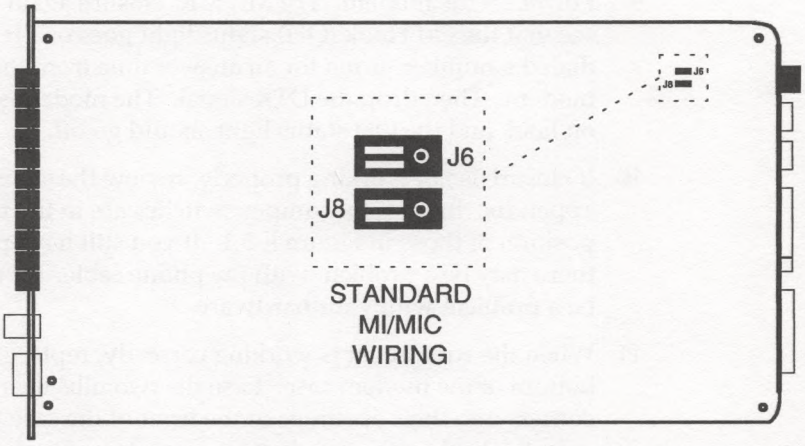


Figure E-1—Courier Modem Board

6. The jumpers are black shunts that cover two out of three upright metal contacts. As shown in the figure, the modem is shipped with the jumpers over the two contacts on each switch that are closest to the front panel. The third contact on each switch is exposed.

   Lift off the jumpers from J6 and J8. Reverse the positions shown in Figure E-5.1. That is, on each switch, cover the contact closest to the back of the modem and the contact at the center. Make sure the jumpers cover two contacts on each switch, or you'll disable the MI/MIC function.

7. Replace the modem in the case top: ease the Voice/Data switch into the opening in the front panel; set the Volume

Control on its semicircular rack; make sure the back of the board rests on the locator pins at the rear (from which you removed the screws).

8. Reconnect the modem's RS-232, power and phone cables, in that order. Be sure the phone cable is plugged into the jack closest to the center of the modem—the jack represented by the wall jack icon on the case bottom label.

   CAUTION: When you power on the modem there will be potential hazardous voltage, particularly near the phone jacks. Do not touch the board when the power is on.

9. Power on the modem. Try MI/MIC closure again. Check to see that the Off Hook (OH) status light goes on. If you dialed a number, listen for an answer tone from the remote modem. Then drop the DTR signal. The modem should go on hook and the OH status light should go off.

10. If closure is not working properly, review the steps in this appendix. Be sure the jumper switches are in the reverse position of those in Figure E-5.1. If you still have problems, there may be a problem with the phone cable. Or there may be a problem with your hardware.

11. When the equipment is working correctly, replace the bottom of the modem case. Ease the two nibs near the front corners into their openings in the front of the case top, and snap the back of the case bottom into place. Replace the two screws and the two vinyl feet.

APPENDIX F. MODEM TESTING

Testing is available with the &T command or Register S16. All loopback testing conforms to CCITT Recommendation, V.54. Earlier USRobotics high speed modems, however, did not perform the &T test repertoire.

NOTE: Only one test can be performed at a given time. If you send a test command while the modem is in test mode, you'll receive an ERROR message.

TESTING WITH &T

The tests supported through the &T command include analog loopback, digital loopback and remote digital loopback. Users can key in their own data during testing, or use the modem's internal test pattern and error detector.

In all cases, disable error control before testing. If the modem is detecting errors and retransmitting the affected data, your results will be invalid.

During testing, the MR status light flashes.

Ending a Test—&T0, S18

Issuing the &T0 command terminates a test. Alternatively, set Register S18 to a specified number of seconds, for example, S18=10. When the 10 seconds are up, the modem automatically ends the test and returns to Command mode. If the test was Analog Loopback, the &T0 command hangs the modem up. If the test was Digital or Remote Digital Loopback, issue an ATH command to hang up the modem, or an ATZ command to hang up the modem and reset it to its defaults.

NOTE: If you use the S18 test timer, but in the process of testing you issue an ATZ command, S18 resets to zero and the timer is disabled. You cannot store a value for S18 in nonvolatile memory: its power-on and reset default is always zero.

ANALOG LOOPBACK—&T1, &T8

This test checks the operation of the modem's transmitter and receiver. Data flow is shown in Figure F-1.

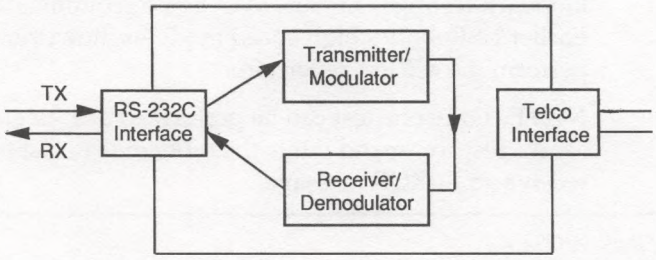


Figure F-1. Data Flow During Analog Loopback

There are two analog loopback options. The first, &T1, involves your typing data that you can verify at your screen.

The second option, &T8, is an internal self-test that does not involve the keyboard or screen. It isolates the modem from the computer interface to give you a more specific result.

NOTE: HST or Dual Standard modems must be tested at *2400 bps or lower* to avoid asymmetrical modulation at higher speeds.

&T1

1. If you are testing an HST or Dual Standard modem, set your terminal or software to 2400 bps.
2. The modem must be in Command mode. If you wish, set Register S18 as a test timer, as explained earlier.
3. Send the modem the following command.

   AT &M0 &T1 <Enter>

   The modem disables error control, enters analog loopback (AL) mode, and sends a CONNECT message. The MR status light flashes.
4. Type recognizable data so that you can verify it when it is looped back to the screen.
5. End the test. If you set S18, the modem automatically stops the test at the timeout, exits AL mode and responds OK.

If you didn't set Register S18, wait one second and type +++ to bring the modem back to Command mode. If DIP switch 9 is UP, the modem also hangs up and ends the test.

If DIP switch 9 is DOWN, type AT&T0 to end the test. Or send either ATH or the command that resets the modem, ATZ. The latter two commands end the test and hang up the modem. The modem responds OK. If the modem sends an ERROR message, you have issued an invalid command.

6. If there were no errors, reset the modem to &M4, for error control, unless you've issued the ATZ reset command.

   NOTE: If the modem is in online-command mode, that is, still connected to a remote modem, and you send it an &T1 or &T8 command, it drops the call, enters AL mode, sends a CONNECT result and waits for loopback characters.

&T8

This AL option causes the modem to send an internal test pattern to its transmitter and loop it back to the receiver. An internal error detector counts any errors and, when the test is ended, sends the number of errors or 000 (no errors) to the screen.

Since you don't type anything during this test, and the modem does not send anything to the screen, this option verifies only the modem. If there are no errors but your problem continues, it may be at the computer interface.

1. If you are testing an HST or Dual Standard modem, set your terminal or software to 2400 bps.
2. The modem must be in Command mode. If you wish, set Register S18 as a test timer, as explained earlier.
3. Send the modem the following command:

   AT &M0 &T8 <Enter>

   The modem disables error control and enters AL mode. The MR status light flashes. The modem sends its internal test pattern to the transmitter, and loops the pattern back to the receiver. You will not see any data on your screen.
4. End the test. If you set S18, the modem automatically stops the test at the timeout. If you didn't set Register S18, type AT&T0 to end the test. Or use ATH or the command that

resets the modem, ATZ. Both of the latter end the test and hang up the modem.

The modem hangs up and returns a three-digit code, followed by OK. A code of 000 indicates no errors were found. A code of 255 indicates 255 or more errors. An ERROR message indicates that you issued an invalid command.

5. If there were no errors, reset the modem to &M4 for error control unless you issued the ATZ command.

&T2

This option is reserved.

DIGITAL LOOPBACK—&T3

If your modem has passed the AL test, this test can help you locate a problem with a remote modem or the telephone channel. Figure F-2 shows the data flow during DL testing.

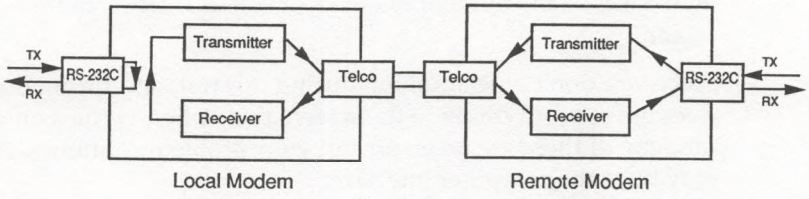


Figure F-2. Data Flow During Digital Loopback

NOTE: This test requires the modem to establish a connection and return to online-command mode in response to the +++ escape code. DIP switch 9 must be set DOWN so that the modem does not hang up on receipt of the escape code. After you change the switch, issue ATZ to the modem to initiate the new setting.

As with AL testing, HST and Dual Standard modems should be tested at 2400 bps or lower,

1. Set the modem to &M0, to disable error control. HST and Dual Standard modems should be set to 2400 bps or lower to avoid asymmetrical modulation at higher speeds. Establish a connection with the remote modem.

2. Bring the modem back to Command mode with the +++ escape code. Then send it the AT&T3 command. The modem enters DL mode and the MR status light flashes.
3. The remote user should type a short message. It will be looped back by your modem's transmitter for verification on the remote screen. You will not see the message or any other data.
4. When the remote user has completed the test, issue the AT&T0 command to end the test. Or send either ATH or the command that resets the modem, ATZ. The latter two commands end the test and hang up the modem. The modem responds OK. If the modem sends an ERROR message, you have issued an invalid command.
5. Reset DIP switch 9 UP if you normally use the factory default. Reset the modem to &M4 unless you used the reset command, ATZ.

&T4, &T5

The &T4 option causes the modem to grant a remote modem's request for a Remote Digital Loopback test.

The &T5 option cancels &T4, and the modem fails to recognize such a request. This is the default so that your modem isn't subject to another user calling and tying up your modem without your permission.

REMOTE DIGITAL LOOPBACK—&T6, &T7

This test, like the local digital loopback test, verifies the condition of both modems and the phone link. Data flow is shown in Figure F-3.

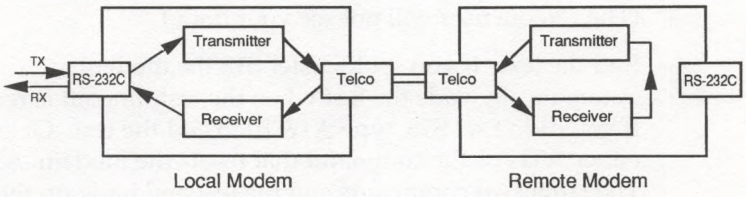


Figure F-3. Data Flow During Remote Digital Loopback

The request for and granting of Remote Digital Loopback testing requires that both modems use CCITT V.22 standard signaling. *The test must be performed at 2400 bps or lower.* If the remote modem does not have the capability or is not set to respond, you will get an ERROR result code.

As with Analog Loopback, there are two Remote Digital Loopback options. If you select &T6, you send keyboard data to the modem and verify it when it is returned over the phone lines and to your screen. If you select &T7, the modem sends its internal test pattern and returns an error count to your screen.

NOTE: Both test options require the modem to establish a connection and return to online-command mode in response to the +++ escape code. DIP switch 9 must be set DOWN so that the modem does not hang up on receipt of the escape code. If necessary, set the switch DOWN and then issue the ATZ command to the modem to initiate the new switch setting.

&T6

1. Set the software to 2400 bps or lower. Set the modem to &M0. If you wish, set the S18 timer.

   Establish a connection with the remote modem. If you haven't already done so, arrange with the remote user to cooperate with your testing and, if necessary, set the remote modem to acknowledge the RDL request. For example, older USRobotics high speed modems need to be set to S16=8.

2. Bring the Modem back to Command mode with the +++ escape code. Send it the AT&T6 command. The modem enters RDL mode and the MR status light flashes.

3. Type a short message. It will be looped back to your modem by the remote modem and to your screen for verification. (The remote user will not see your data.)

4. End the test. If you set Register S18 the modem automatically ends the test when the test timeout is reached. If you didn't set S18, type AT&T0 to end the test. Or send either ATH or the command that resets the modem, ATZ. The latter two commands end the test and hang up the modem. The modem responds OK. If you issue an invalid command, the modem sends an ERROR message.

Data errors indicate a problem with the remote modem or the phone link. If you have not performed analog loopback testing with your modem, the problem may also lie with your modem.

5. Reset DIP switch 9 UP unless you normally set that switch DOWN, and issue ATZ to the modem to initiate the new setting. Reset the modem to &M4 unless you used the reset command, ATZ.

&T7

This test option causes the modem to send an internal test pattern through the Remote Digital Loopback. An internal error detector counts any errors and, when the test is ended, sends the number of errors or 000 (no errors) to the screen.

You don't need to type anything during this test. The modem sends only its final error count to your screen.

1. Set the software to 2400 bps or lower. Set the modem to &M0. If you wish, set the S18 timer.

   Establish a connection with the remote modem. If you haven't already done so, arrange with the remote user to cooperate with your testing and, if necessary, set the remote modem to acknowledge the RDL request. For example, older USRobotics high speed modems need to be set to S16=8.

2. Bring the modem back to Command mode with the +++ escape code. Then send it the AT&T7 command. The modem enters RDL mode and the MR status light flashes.

   The modem sends its internal test pattern to the remote modem, which loops it back to your modem. You will not see the data on your screen.

3. End the test. If you set S18, the modem automatically stops the test when the timer times out. If you didn't set Register S18, type AT&T0 to end the test. Or send either ATH or the command that resets the modem, ATZ. The latter two commands end the test and hang up the modem. The modem responds OK. If you issue an invalid command, the modem sends an ERROR message.

   When you terminate the test, the modem returns a three-digit code, followed by OK. A code of 000 indicates no

errors were found. A code of 255 indicates 255 or more errors.

If you've performed an Analog Loopback and know your modem is working properly, errors indicate a problem with either the phone connection or the remote modem.

4. Reset DIP switch 9 UP unless you normally operate with it DOWN. Issue an ATZ command to initiate the new switch setting. Reset the modem to &M4 unless you've sent it the ATZ reset command.

TESTING WITH REGISTER S16

Register S16 is a bit mapped register with the following bit functions:

Bit	Value	Function
0	1	Analog Loopback (AL)
1	2	Dial Test
2	4	Test Pattern
3	8	Remote Digital Loopback (RDL)

NOTE: Earlier USRobotics modems require bit 3 to be enabled in order to grant RDL to a remote modem. The modem now requires its default &T4 setting instead. To perform RDL with a USRobotics modem that does not use the &T test repertoire, that modem should be set to S16=8 before it can grant RDL testing.

ANALOG LOOPBACK (AL)—S16=1D

As with the &T AL test, do not attempt this test under error control. HST and Dual Standard modems should be tested at 2400 bps or lower, to avoid asymmetrical modulation at higher speeds.

To use the modem's Test Pattern (S16, bit 2) instead of typing your own data, see *Test Pattern—S16=4* later in this appendix.

1. To initiate testing, type AT&M0S16=1D. The modem disables error control, enters AL mode and sends a CONNECT result code. The MR status light flashes.

2. Type data to the modem for the modem to transmit, loop to its receiver, and output to the screen. An alternative is to use the *Test Pattern*, described later.

3. End the test by not typing anything for one second, then typing three pluses (+++), and waiting another second. This forces the modem back to command mode. If DIP switch 9 is UP, the modem exits AL mode and returns to Command mode. If DIP switch 9 is DOWN, the modem maintains the connection when it receives the +++ escape code. Issue the ATH command to end AL mode.
4. Reset the modem to Data mode, S16=0, and error control (&M4), or issue the ATZ (reset) command.

DIAL TEST—S16=2

The Dial Test is used for factory testing the frequencies of Touch-Tone values. When S-Register 16 is set to 2 and a single Touch-Tone is dialed (e.g., ATD7 <Enter>), the modem continues to transmit that tone until you type another Carriage Return.

TEST PATTERN—S16=4

The test pattern can be used instead of your typed data during Analog Loopback (AL) or Remote Digital Loopback (RDL), using &T commands or S16. The test pattern is available at all speeds. At 300 bps, the modem's DTE rate must be fixed (&B1) and the link rate fixed at 300 bps (&N1). At rates over 9600 bps, just set the modem for a fixed DTE rate (&B1).

To use the test pattern during AL testing with S16, type the following command. The test pattern is sent through the loopback.

AT&M0S16=5D

To use the test pattern during RDL testing with S16, type the following command.

AT&M0S16=12

To use the test pattern with the &T AL or RDL tests, insert the test pattern command, S16=4, before issuing the test command. The first of the following commands initiates AL, the second RDL:

ATS16=4&T1
ATS16=4&T6

The test pattern alone (ATS16=4) is used for testing equipment and the phone line. When S16 is set to 4, the modem transmits the test pattern upon connection with a remote modem.

Ending Testing with the Test Pattern

Pressing any character key cancels all test pattern tests and hangs up the modem. If you used Register S16, be sure to reset Register S16 to Data mode when you reset the modem to its error control defaults, for example, ATZ or AT&M4S16=0.

REMOTE DIGITAL LOOPBACK—S16=8

Responding Modem

The responding modem must be ready to act on the Courier's RDL request. USRobotics high speed modems should be set to &T4. If they do not have &T testing capability, they should be set to S16=8.

Initiating Modem

1. If DIP switch 9 UP, set it DOWN so that it does not hang up on receipt of the +++ escape code. Issue an ATZ command to initiate the new switch setting.
2. Set the software to 2400 or 1200 bps. The CCITT-specified RDL signals are defined only for connections at 2400 or 1200 bps.
3. Disable error control by setting the modem to &M0. Then establish a connection with the remote modem.
4. Bring the modem back to Command mode by sending it the escape code: one second of no data, three pluses (+++), and another second of no data.
5. When the OK result code appears, send the modem the following command.

   ATS16=8 O

   The modem enters RDL mode (S16=8), the MR status light flashes, and the modem goes back online (O command). Then it transmits the CCITT-defined RDL signals, causing the remote modem to enter RDL mode.
6. Type any data at the keyboard. (Or send the test pattern.)

7. To end the test, send the modem the +++ escape code again to bring it back to Command mode.

8. When the modem sends the OK result, reset the modem to Data mode with the following command.

   ATS16=0

   The modem signals the responding modem that RDL testing is over. Terminate the call as you normally would, and reset the modem to its normal error control setting, &M4 or &M5.

   Or, if you wish to resume data transmission with the remote modem, add the O command to the ATS16=0 string to return the modem online. Keep in mind, however, that error control is disabled. Because error control is negotiated during the connection sequence, its status cannot be changed until the modem is back on hook and in Command mode.

APPENDIX G. GLOSSARY

Cross-references in the following definitions are printed in boldface.

Analog Loopback

A modem self-test in which data from the keyboard is sent to the modem's transmitter, modulated into **analog** form, looped back to the receiver, demodulated into **digital** form, and returned to the screen for verification.

Analog Signals

Continuous, varying waveforms such as the voice tones carried over phone lines. Contrast with **digital signals**.

Answer Mode

A state in which the modem transmits at the predefined high frequency of the communications channel and receives at the low frequency. The transmit/receive frequencies are the reverse of the calling modem which is in **Originate mode**.

ARQ

Automatic Repeat Request. A general term for error control protocols which feature error detection and automatic retransmission of defective blocks of data. See **HST**, **MNP**, and **V.42**.

ASCII

American Standard Code for Information Interchange. A 7-bit binary code (0's, 1's) used to represent letters, numbers, and special characters such as $, !, and /. Supported by almost every computer and terminal manufacturer.

Asymmetrical Modulation

A duplex transmission technique which splits the communications channel into one high speed channel and one slower channel. During a call under asymmetrical modulation, the modem with the greatest amount of data to transmit is allocated the high speed channel. The modem with less data is allocated the slow, or back channel (450 bps). The modems dynamically reverse the channels during a call if the volume of data transfer changes.

Asynchronous Transmission

Data transmission in which the length of time between transmitted **characters** may vary.

Because the time lapses between transmitted characters are not uniform, the receiving modem must be signaled as to when the data bits of a character begin and when they end. The addition of **Start** and **Stop bits** to each character serves this purpose.

Auto Answer

A feature in modems enabling them to answer incoming calls over the phone lines without the use of a telephone receiver.

Auto Dial

A feature in modems enabling them to dial phone numbers over the phone system without the use of a telephone transmitter.

Baud Rate

The number of discrete signal events per second occurring on a communications channel. Although not technically accurate, baud rate is commonly used to mean **bit rate**.

Bisync

Binary Synchronous Control. An earlier protocol developed by IBM for software applications and communicating devices operating in synchronous environments. The protocol defines operations at the link level of communications, for example, the format of data **frames** exchanged between modems over a phone line. See **Protocol**, **HDLC**, **SDLC**.

Binary Digit

A 0 or 1, reflecting the use of a binary numbering system (only two digits). Used because the computer recognizes either of two states, OFF or ON. Shortened form of binary digit is **bit**.

Bit Rate

The number of **binary digits**, or bits, transmitted per second (**bps**). Communications channels using telephone channel modems are established at set bit rates, commonly 110, 300, 1200, 2400, 4800, 9600, and 14400.

BPS

The bits (**binary digits**) per second rate.

Buffer

A memory area used as temporary storage during input and output operations. An example is the modem's command buffer. Another is the Transmit Data flow control buffer used for flow control and to store copies of transmitted **frames** until they are positively acknowledged by the receiving modem.

Byte

A group of **binary digits** stored and operated upon as a unit. A byte may have a coded value equal to a character in the ASCII code (letters, numbers), or have some other value meaningful to the computer. In user documentation, the term usually refers to 8-bit units or characters. 1 kilobyte (K) is equal to 1,024 bytes or characters; 64K indicates 65,536 bytes or characters.

Carrier

A continuous frequency capable of being either modulated or impressed with another information-carrying signal. Carriers are generated and maintained by modems via the transmission lines of the telephone companies.

CCITT

An international organization that defines standards for telegraphic and telephone equipment. For example, the Bell 212A standard for 1200 bps communication in North America is observed internationally as CCITT V.22. For 2400 bps communication, most U.S. manufacturers observe V.22 *bis*. The initials CCITT represent the French name; in English it's known as the International Telegraph and Telephone Consultative Committee.

Character

A representation, coded in **binary digits**, of a letter, number, or other symbol.

Characters Per Second

A data transfer rate generally estimated from the **bit rate** and the **character** length.

For example, at 2400 bps, 8-bit characters with **Start** and **Stop bits** (for a total of ten bits per character) will be transmitted at a rate of approximately 240 characters per second (cps). Some protocols, such as USR-HST and MNP, employ advanced tech-

niques such as longer transmission **frames** and **data compression** to increase cps.

Cyclic Redundancy Checking (CRC)

An error-detection technique consisting of a cyclic algorithm performed on each block or **frame** of data by both sending and receiving modems. The sending modem inserts the results of its computation in each data block in the form of a CRC code. The receiving modem compares its results with the received CRC code and responds with either a positive or negative acknowledgment. In the ARQ protocol implemented in USRobotics high speed modems, the receiving modem accepts no more data until a defective block is received correctly.

Data Communications

A type of communications in which computers and terminals are able to exchange data over an electronic medium.

Data Compression Table

A table of values assigned for each character during a call under data compression. Default values in the table are continually altered and built during each call: the longer the table, the more efficient throughput gained.

If a destructive Break is sent during a call (see the &Y command), causing the modems to reset the compression tables, you can expect diminished throughput.

DCE

Data Communication (or Circuit-Terminating) Equipment. In this manual, the term applies to dial-up modems that establish and control the data link via the telephone network.

Dedicated Line

A user-installed telephone line used to connect a specified number of computers or terminals within a limited area, for example, one building. The line is a cable rather than a public-access telephone line. The communications channel may also be referred to as nonswitched because calls do not go through telephone company switching equipment.

Default

Any setting assumed, at startup or reset, by the computer's software and attached devices, and operational until changed by the user.

Digital Loopback

A test that checks the modem's RS-232 interface and the cable that connects the terminal or computer and the modem. The modem receives data (in the form of **digital signals**) from the computer or terminal, and immediately returns the data to the screen for verification.

Digital Signals

Discrete, uniform signals. In this manual, the term refers to the **binary digits** 0 and 1.

DTE

Data Terminal (or Terminating) Equipment. The device that generates or is the final destination of data. In this manual, the term refers to your computer.

Duplex

Indicates a communications channel capable of carrying signals in both directions. See **Half Duplex**, **Full Duplex**.

EIA

Electronic Industries Association, which defines electronic standards in the U.S.

Equalization

A compensation circuit designed into modems to counteract certain distortions introduced by the telephone channel. Two types are used: fixed (compromise) equalizers and those that adapt to channel conditions. USRobotics high speed modems use adaptive equalization.

Error Control

Various techniques which check the reliability of characters (**parity**) or blocks of data. V.42, MNP and HST error control protocols use error detection (**CRC**) and retransmission of errored frames (**ARQ**).

Flow Control

A mechanism that compensates for differences in the flow of data input to and output from a modem or other device.

Frame

A data communications term for a block of data with header and trailer information attached. The added information usually includes a frame number, block size data, error-check codes, and Start/End indicators.

Full Duplex

Signal flow in both directions at the same time. In microcomputer communications, may refer to the suppression of the online **Local Echo**.

Half Duplex

Signal flow in both directions, but only one way at a time. In microcomputer communications, may refer to activation of the online **Local Echo**, which causes the modem to send a copy of the transmitted data to the screen of the sending computer.

HDLC

High Level Data Link Control. A standard protocol developed by the International Standards Organization for software applications and communicating devices operating in synchronous environments. The protocol defines operations at the link level of communications, for example, the format of data **frames** exchanged between modems over a phone line. See **Bisync**, **Protocol**, **SDLC**.

HST

High Speed Technology, USRobotics' proprietary signaling scheme, design and error control protocol for high-speed modems. HST incorporates trellis-coded modulation, for greater immunity from variable phone line conditions, and asymmetrical modulation for more efficient use of the phone channel at speeds of 4800 bps and above. HST also incorporates **MNP**-compatible error control procedures adapted to asymmetrical modulation.

Hz

Hertz, a frequency measurement unit used internationally to indicate one cycle per second.

LAPM

Link Access Procedure for Modems, an error control **protocol** incorporated in CCITT Recommendation V.42. Like the **MNP** and **HST** protocols, LAPM uses cyclic redundancy checking (**CRC**) and retransmission of corrupted data (**ARQ**) to ensure data reliability.

Local Echo

A modem feature that enables the modem to send copies of keyboard commands and transmitted data to the screen. When the modem is in Command mode (not online to another system) the local echo is invoked through the ATE1 command. The command causes the modem to display your typed commands. When the modem is online to another system, the local echo is invoked through the ATF0 command. This command causes the modem to display the data it transmits to the remote system.

MI/MIC

Mode Indicate/Mode Indicate Common, also called Forced or Manual Originate. Provided for installations where other equipment, rather than the modem, does the dialing. In such installations, the modem operates in Dumb mode (no Auto Dial capability), yet must go off hook in **Originate mode** to connect with answering modems. See MI/MIC Closure in Chapter 2.

MNP

Microcom Networking Protocol, an asynchronous error control protocol developed by Microcom, Inc. and now in the public domain. The protocol ensures error-free transmission through error detection (**CRC**) and retransmission of errored frames. USRobotics modems use MNP Levels 1–4 and Level 5 data compression. MNP Levels 1–4 have been incorporated into CCITT Recommendation V.42. Compare **HST**.

Modem

A device that transmits/receives computer data through a communications channel such as radio or telephone lines. The Courier is a telephone channel modem that modulates, or trans-

forms, **digital signals** from a computer into the **analog** form that can be carried successfully on a phone line. It also demodulates signals received from the phone line back to digital signals before passing them to the receiving computer.

Nonvolatile Memory (NVRAM)

User-programmable random access memory whose data is retained when modem power is turned off. Used in Courier modems to store a user-defined default configuration loaded into random access memory (**RAM**) at power on.

OFF/ON Hook

Modem operations which are the equivalent of manually lifting a phone receiver (taking it off hook) and replacing it (going on hook).

Online Fallback

A feature that allows high speed error-control modems to monitor line quality and fall back to the next lower speed if line quality degrades. The modems fall forward as line quality improves.

Originate Mode

A state in which the modem transmits at the predefined low frequency of the communications channel and receives at the high frequency. The transmit/receive frequencies are the reverse of the called modem which is in **Answer mode**.

Parallel Transmission

The transfer of data characters using parallel electrical paths for each bit of the character, for example, 8 paths for 8-bit characters. Data is stored in computers in parallel form, but may be converted to serial form for certain operations. See **Serial Transmission**.

Parity

An error-detection method that checks the validity of a transmitted character. Character checking has been surpassed by more reliable and efficient forms of block-checking, including **Xmodem**-type protocols and the **ARQ** protocol implemented in Courier modems.

The same type of parity must be used by two communicating computers, or both may omit parity. When parity is used, a parity bit is added to each transmitted character. The bit's value is 0 or 1, to make the total number of 1's in the character even or odd, depending on which type of parity is used.

Protocol

A system of rules and procedures governing communications between two or more devices. Protocols vary, but communicating devices must follow the same protocol in order to exchange data. The format of the data, readiness to receive or send, error detection and error correction are some of the operations that may be defined in protocols.

RAM

Random Access Memory. Memory that is available for use when the modem is turned on, but that clears of all information when the power is turned off. The modem's RAM holds the current operational settings, a flow control **buffer**, and a command buffer.

Remote Digital Loopback

A test that checks the phone link and a remote modem's transmitter and receiver. Data entered from the keyboard is transmitted from the initiating modem, received by the remote modem's receiver, looped through its transmitter, and returned to the local screen for verification.

Remote Echo

A copy of the data received by the remote system, returned to the sending system and displayed on the screen. Remote echoing is a function of the remote system.

ROM

Read Only Memory. Permanent memory, not user-programmable. The Courier's factory settings are stored in ROM and can be read (loaded) into RAM as an operational configuration if DIP switch S10 is ON at power on.

Serial Transmission

The transfer of data characters one bit at a time, sequentially, using a single electrical path. See **Parallel Transmission**.

Start/Stop Bits

The signaling bits attached to a character before the character is transmitted during **Asynchronous Transmission**.

SDLC

Synchronous Data Link Control. A protocol developed by IBM for software applications and communicating devices operating in IBM's Systems Network Architecture (SNA). The protocol defines operations at the link level of communications, for example, the format of data **frames** exchanged between modems over a phone line. See **Bisync**, **Protocol**, **HDLC**.

Synchronous Transmission

A form of transmission in which blocks of data are sent at strictly timed intervals. Because the timing is uniform, no **Start** or **Stop bits** are required. Compare **Asynchronous Transmission**.

Some mainframes only support synchronous communications unless their owners have installed a synchronous adapter and appropriate software.

Terminal

A device whose keyboard and display are used for sending and receiving data over a communications link. Differs from a microcomputer in that it has no internal processing capabilities. Used to enter data into or retrieve processed data from a system or network.

Terminal Mode

An operational mode required for microcomputers to transmit data. In Terminal mode the computer acts as if it were a standard terminal such as a teletypewriter, rather than a data processor. Keyboard entries go directly to the modem, whether the entry is a modem command or data to be transmitted over the phone lines. Received data is output directly to the screen. The more popular communications software products control Terminal mode as well as enable more complex operations, including file transmission and saving received files.

Throughput

The amount of actual user data transmitted per second without the overhead of protocol information such as Start and Stop bits or frame headers and trailers. Compare **characters per second**.

Transmission Rate

Same as **Bit Rate**.

V.21

A **CCITT** standard for modem communications at 300 bps. Modems made in the U.S. or Canada follow the Bell 103 standard. However, the modem can be set to answer V.21 calls from overseas. See Register S27 in Chapter 6.

V.22

A **CCITT** standard for modem communications at 1200 bps, compatible with the Bell 212A standard observed in the U.S. and Canada.

V.22 bis

A **CCITT** standard for modem communications at 2400 bps. The standard includes an automatic link negotiation fallback to 1200 bps and compatibility with Bell 212A/V.22 modems.

V.23

A **CCITT** standard for modem communications at 1200 bps with a 75 bps back channel. Used in the U.K.

V.25

A **CCITT** standard for modem communications that specifies an answer tone different from the Bell answer tone used in the U.S. and Canada. All USRobotics modems can be set with the B0 command so that they use the V.25 2100 Hz tone when answering overseas calls.

V.32

A **CCITT** standard for modem communications at 9600 bps and 4800 bps. V.32 modems fall back to 4800 bps when line quality is impaired, and fall forward again to 9600 bps when line quality improves.

V.32 bis

A **CCITT** standard that extends the V.32 connection range: 4800, 7200, 9600, 12K and 14.4K bps. V.32 *bis* modems fall back to the next lower speed when line quality is impaired, and fall back further as necessary. They fall forward to the next higher speed when line quality improves.

V.42

A **CCITT** standard for modem communications that defines a two-stage process of detection and negotiation for LAPM error control. V.42 also supports the MNP error control protocol, levels 1–4.

V.42 bis

An extension of **CCITT** V.42 that defines a specific data compression scheme for use with V.42 and MNP error control.

Word Length

The number of bits in a data character without parity, start or stop bits.

Xmodem

The first of a family of error control software **protocols** used to transfer files between modems. These protocols are in the public domain and are available from many bulletin board services.

XON/XOFF

Standard **ASCII** control characters used to tell an intelligent device to stop/resume transmitting data. In most systems typing <Ctrl>-S sends the XOFF character. Some devices, including the Courier, understand <Ctrl>-Q as XON; others interpret the pressing of any key after <Ctrl>-S as XON.

APPENDIX H. TECHNICAL SPECIFICATIONS

USROBOTICS HIGH SPEED TECHNOLOGY (HST)

14.4K bps, synchronous/asynchronous, asymmetrical, 14.4K/450 or 14.4K/300 bps with automatic handshake adjustment to 300 bps, Trellis Coded Modulation (TCM), Quadrature Amplitude Modulation (QAM)

12K bps, synchronous/asynchronous, asymmetrical, 12K/450 or 12K/300 bps with automatic handshake adjustment to 300 bps, Trellis Coded Modulation (TCM), Quadrature Amplitude Modulation (QAM)

9600 bps, synchronous/asynchronous, asymmetrical, 9600/450 or 9600/300 bps with automatic handshake adjustment to 300 bps, Trellis Coded Modulation (TCM), Quadrature Amplitude Modulation (QAM)

7200 bps, synchronous/asynchronous, asymmetrical, 7200/450 or 7200/300 bps with automatic handshake adjustment to 300 bps, Trellis Coded Modulation (TCM), Quadrature Amplitude Modulation (QAM)

4800 bps, synchronous/asynchronous, asymmetrical, 4800/450 or 4800/300 bps with automatic handshake adjustment to 300 bps, Quadrature Amplitude Modulation (QAM)

CCITT V.32 BIS

14.4K bps, synchronous/asynchronous, Trellis Coded Modulation (TCM)

12K bps, synchronous/asynchronous, Trellis Coded Modulation (TCM)

9600 bps, synchronous/asynchronous, Trellis Coded Modulation (TCM)

7200 bps, synchronous/asynchronous, Trellis Coded Modulation (TCM)

4800 bps, synchronous/asynchronous, Quadrature Amplitude Modulation (QAM)

ADDITIONAL COMPATIBILITY FEATURES

CCITT V.25 2100 Hz tone

CCITT V.23, 1200 bps, asymmetrical (1200/75 bps), Frequency Shift Keying (FSK)

CCITT V.22 *bis*, 2400 bps, synchronous/ asynchronous, Quadrature Amplitude Modulation (QAM)

CCITT V.22, 1200 bps, synchronous/asynchronous, Differential Phase Shift Keying (DPSK)

Bell 212A, 1200 bps, synchronous/asynchronous, Differential Phase Shift Keying (DPSK)

Bell 103, 300/110 bps, asynchronous, Frequency Shift Keying (FSK)

CCITT V.21, 300 bps, asynchronous, Frequency Shift Keying (FSK)

300/110 bps, asynchronous, variable Frequency Shift Keying (FSK)

USRobotics HST error control protocol, asymmetrical mode, at 14.4K/12K/9600/7200/4800 bps, 450/300 bps back channel

CCITT V.42 error control protocol at 14.4K/12K/9600/7200/4800 bps (V.32 *bis* mode) and at 2400/1200 bps

CCITT V.42 *bis* data compression

Microcom Networking Protocol (MNP) error control protocol, Levels 2-4 at 14.4K/12K/9600/7200/4800 bps (V.32 *bis* mode) and at 2400/1200 bps

Microcom Networking Protocol (MNP) Level 5 data compression at 14.4K/12K/9600/7200/4800/2400/1200 bps

DB-25 RS-232 terminal/modem interface

Superset of industry standard AT command set, S-registers, DIP switches

Optional MI/MIC closure

Optional pulsed DSR

DTE RATES

38.4K, 19.2K, 9600, 4800, 2400, 1200, 300, 110 bps

LINK RATES

14.4K, 12K, 9600, 7200, 4800, 2400, 1200, 300, 110 bps

ONLINE FALLBACK/FALL FORWARD

14.4K, 12K, 9600, 7200, 4800 bps

PHONE LINE INTERFACE

RJ11, RJ45S phone jacks

COMMUNICATIONS CHANNEL

Full/half duplex on 2-wire dial-up, dedicated, or leased phone lines; demand-driven high speed channel turnaround in HST mode; symmetrical speeds in V.32 *bis* mode

OPERATIONAL MODES

Synchronous/Asynchronous, Auto Dial/Answer, Manual Originate/Answer, Smart/Dumb mode

DIALING

Rotary (pulse 0-9), Touch-Tone (DTMF 0-9, #, *), a-z when in Quote (") Mode

DATA FORMAT

Binary, serial; defaults to 7-bit word length, even parity

Start Bits	Data Bits	Parity	Stop Bits
1	7	Even, Odd Mark, Space	1
1	7	None, Even, Odd, Mark, Space	2
1	8	None	1, 2

FRONT PANEL STATUS LIGHTS

HS	High Speed (above 2400 bps)
AA	Auto Answer/Answer
CD	Carrier Detect
OH	Off Hook
RD	Received Data
SD	Send Data
TR	Terminal Ready (DTR)
MR	Modem Ready/Test Mode
RS	Request to Send
CS	Clear to Send
SYN	Synchronous Mode
ARQ	Error control connection established

FLOW CONTROL BUFFERS

Transmit Buffer

Error control: 3.25k bytes

Non-Error control: 1.5k bytes, 128-byte option

Receive Buffer: 2K bytes

COMMAND BUFFER

40 characters, exclusive of AT prefix, Carriage Return and spaces

TEST OPTIONS

Analog loopback with test pattern
Remote digital loopback
Digital loopback
Test pattern
Dial test

CALL PROGRESS CODES

NO DIAL TONE
BUSY
NO ANSWER
RINGING
VOICE

FAILED CALL TIMEOUT

60-sec. default, programmable 2-255 sec.

ANSWER TONE TIMEOUT

60 sec.

ANSWER TONE DETECTOR

2200-2300 Hz

LOSS OF CARRIER (DISCONNECT TIMER)

0.7-sec. default, programmable 0.2-25.5 sec.

EQUALIZATION

Adaptive

TRANSMITTER CARRIER FREQUENCIES

USR-HST, 450 bps back channel
Originate Mode: 375 Hz
Answer Mode: 1800 Hz

USR-HST, 300 bps back channel
Originate Mode: 350 Hz
Answer Mode: 1800 Hz

V.32 *bis*
Originate Mode: 1800 Hz
Answer Mode: 1800 Hz

V.23
Originate Mode:
Mark: 390 Hz
Space: 450 Hz
Answer Mode:
Mark: 1300 Hz
Space: 2100 Hz

V.22 *bis*, V.22, Bell 212A
Originate Mode: 1200 Hz
Answer Mode: 2400 Hz

Bell 103
Originate Mode:
Mark: 1270 Hz
Space: 1070 Hz
Answer Mode:
Mark: 2225 Hz
Space: 2025 Hz

V.21
Originate Mode:
Mark: 980 Hz
Space: 1180 Hz
Answer Mode:
Mark: 1650 Hz
Space: 1850 Hz

RECEIVER CARRIER FREQUENCIES

USR-HST, 450 bps back channel
Originate Mode: 1800 Hz
Answer Mode: 375 Hz

USR-HST, 300 bps back channel
Originate Mode: 1800 Hz
Answer Mode: 350 Hz

V.32 *bis*
Originate Mode: 1800 Hz
Answer Mode: 1800 Hz

V.23
Originate Mode:
Mark: 1300 Hz
Space: 2100 Hz
Answer Mode:
Mark: 390 Hz
Space: 450 Hz

V.22 *bis*, V.22, Bell 212A
Originate Mode: 2400 Hz
Answer Mode: 1200 Hz

Bell 103
Originate Mode:
Mark: 2225 Hz
Space: 2025 Hz
Answer Mode:
Mark: 1270 Hz
Space: 1070 Hz

V.21
Originate Mode:
Mark: 1650 Hz
Space: 1850 Hz
Answer Mode:
Mark: 980 Hz
Space: 1180 Hz

RECEIVE SENSITIVITY

- 44 dBm $\pm$ 2 dBm

TRANSMIT LEVEL

- 9 dBm maximum

TRANSMITTER FREQUENCY TOLERANCE

.01%

CERTIFICATION

FCC Part 68 and Part 15, Class B Domestic; DOC (Canada), UL listed

POWER CONSUMPTION

5 watts

SIZE

8.30 x 12.65 x 1.57 inches

INDEX

A

ACK character, HP installations, 4-6, 4-11, E-11
Adaptive dialing, 5-8, 6-4
Adaptive Speed Leveling, ASL, 1-1
Advanced result code subsets, 5-5—5-6
Analog loopback (AL)
  S16,F-8—F-9
  &T, F-2—F-3
Answer mode
  auto answer, 6-11—6-12
  DIP switch 5, B-7
  error control and, 4-6
.ARC file transfer, A-9
ARQ (Automatic Repeat Request)
  CONNECT result codes (&A), 5-5—5-6
  definition, 4-1, A-1, G-1
  disconnect reason (ATI6), 8-4
  during testing, App. F
  flow control requirement, 3-2, 4-4, 4-6
  mode select (&M, &D), 4-5, 4-17
  operations, A-7
  timeout, retransmit maximum, 5-10, 8-4, B-16
  with Auto Answer, 4-6
ASCII
  changing definitions, B-12
  chart, B-21, Reference Card
  compatibility, 1-5
Assembly, modem, 2-4—2-6
  RS-232 cable requirements, 2-2—2-3, B-2—B-3
Asterisk, dialing (*), 6-4
Asymmetrical modulation, 3-1, G-1
Asynchronous transmission, 1-2, H-1, G-2
Audio monitor (speaker), 5-10
Auto answering, 6-11—6-12
  disabling, 6-12, B-7
  number of rings on which to answer (S0), B-12
  with Dip switch 5, 6-12, B-7
Auto dialing, 6-3—6-9
  Help screen (D$), 8-8
  stored phone numbers, 8-6
Automatic Repeat Request, see ARQ

B

Back channel, 4-2—4-3, H-1
  forcing 300-bps, S15, B-15
Backspace key, ASCII definition (S5), B-12
Baud rate, G-2
Bisync, 7-1, G-2
Bits per second (bps)
  defined, G-2
  link negotiation, 3-5, 4-15, A-1—A-5
  online fallback, 3-6, A-1, A-4, A-5
  rate recognition, 4-13—4-15, 6-1, E-5
  setting the, 6-2
Break handling (&Y), 5-11
Break length, modem to terminal (S21), B-16
Buffers
  command, 6-8, 6-9
  flow control, 4-6
Busy answer, 5-6—5-7, 6-7—6-8

C

Calling another modem, 3-5, 6-3—6-11
  at another extension, E-8
  at 110/300 bps, 4-16
  at a fixed link rate, 4-15
  overseas, 6-12—6-13
Call duration reporting (K), 5-11
Call progress messages, 5-4—5-8
Call waiting (S10), B-13
Canadian certification (DOC), xi, xiii, 6-9
Carrier, defined, 5-10
Carrier Detect (CD) override (DIP switch 6, &C), 4-17—4-18, B-7
CTS following, 4-7, 4-8, 4-9, B-5
CCITT
  answer tone (B, V.32), 6-12—6-13, A-3—A-4
  defined, G-3
  V.21, 1-4 , 6-1, B-17
  V.25, 1-4, 6-1
  V.32, 1-4, 6-1
  V.32 bis, 1-4, 6-1
  V.42, 1-5, 6-1
  V.42 bis, 1-5, 6-1, A-9
  V.54, 1-3, 1-5, 6-1, App. F

Channel, turnaround, 4-2—4-3
Characters per second (cps), A-9, G-3
  maximum throughput, 4-3—4-5, A-9
Clear to Send (CTS), 4-7, 4-8, 4-9, B-5
Clock, Courier (K), 5-11
Command format, 3-4, 6-2
Command mode local echo (E), 2-8, 5-9
Commands
  Adaptive dialing (X2—X6), 5-8, 6-4
  Alphabetical listing, App. C
  Answer mode, 6-11
  ARQ mode select (&M), 4-5
  Advanced ARQ result code subsets (&A), 5-5—5-6
  AT (attention), 2-7—2-8,
  Break handling (&Y), 5-11
  Cancel dialing (any key), 6-3
  Carriage return (<Enter>)
    ASCII definition (S3), B-12
    to enter commands, 2-8
  Carrier detect, CD (&C), 4-17—4-18
  CCITT answer tone (B), 6-12—6-13, A-3—A-4
  Clock usage (K), 5-11
  Comma (pause), 6-4
  Command mode local echo (E), 2-8, 5-9
  Compression, data (&K), see *data compression*
  Data rate select
    DTE rate (&B), 4-14—4-15
    Link rate (&N), 4-15—4-16
  Data set ready, DSR (&S), 4-16
  Data terminal ready, DTR (&D), 4-17, B-6
  Dial (D), 3-5, 6-3
    last dialed number (DL), 6-8
    letter strings ("), 6-5
    Help screen (D$), 8-8
    stored phone number (DS), 8-6
  Disable transmitter (C), 5-11
  Disconnect (H, +++), 6-9, 6-11
  Duplex, 5-9
  DTE/modem rate select (&B), 4-13
  Echo, local (E, F), 2-8, 5-9
  Error Control (&M), 4-5
  Escape code (+++), 6-9
  Factory settings, loading (&F), 5-2
  Flow control
    received data (&I, &R), 4-9—4-10
    transmit data (&H), 4-7
  Guard tone (&G), 6-13
Hang up (H, +++), 6-9—6-11
Help screens, using, 8-6
  ampersand commands (&$), 8-7
  basic commands ($), 8-7
  dialing (D$), 8-8
  S-register functions (S$), 8-9
Inquiry options (I), 8-1—8-5
  call-duration (I3), 8-1
  current settings display (I4), 8-1, 8-2
  link diagnostics display (I6), 8-3
  NRAM settings display (I5), 8-2
  product configuration, 8-5
Last dialed number (DL), 6-8
Link rate select (&N), 4-15
Local echo (E, F), 2-8, 5-9
MNP mode select (&M), 4-5
Online local echo (F), 2-8, 5-9
Pause (,), 6-4
Percent commands, 4-18
Phone number storage (&Zn=s), 5-3
Pulse dial make/break ratio (&P), 6-13
Pulse/Touch-Tone dial (P/T), 6-4
Punctuation, 6-3
Quiet mode (Q), 5-4
RCU access (&R), 4-18
Receive only, disable transmitter (C), 5-11
Received data flow control (&I, &R), 4-9—4-10
Redial/re-execute previous command
  one time (A/), 6-8
  continuous, (A>), 6-8
Repeat, continuous (>), 6-8
Reset to NRAM defaults (Z), 5-3
Response modes (V), 5-4
Result code sets (X), 5-6—5-8
Return online after +++ (O), 6-11
Reverse frequencies (R), 6-7
Save in NRAM
  modem settings (&W), 5-1
  phone numbers (&Zn=s), 5-3
Settings status display
  current settings (I4), 8-1—8-2
  NRAM settings (I5), 8-2
Speaker control (M), 5-10
S-register settings (Sr=n), App. B-5
Summary, App. C
Testing (&T), App. F
Touch-Tone/pulse dial (P/T), 6-4
Touch-Tone recognition (%T), 4-18

Transfer call (!), 6-6
Transmit data flow control (&H), 4-7—4-8
Verbal/numeric response modes (V), 5-4
Wait for second dial tone (W), 6-5
Wait for answer (@), 6-6
Write to NRAM
modem settings (&W), 5-1
phone numbers (&Zn=s), 5-3
Compatibility, 1-4—1-5, 6-1, H-1
error control, 4-5, A-5
Compression, see Data compression
Components, 2-1
Computer interface (DTE) speed select (&B), 4-14
Configuration, general
DIP switches, 2-6, B-6—B-8
factory defaults, 5-2, B-6—B-8
interface controls, 4-1—4-2
internal controls, 5-1
NRAM options, 5-10
physical assembly,2-1—2-3
S-registers, B-12—B-20
Configuration to call:
at 110/300 bps, 4-16
HST-compatibles, 3-1, 4-2—4-3
non-MNP compatibles, 3-4, 6-3
V.32 bis-compatibles, 4-2
CONNECT messages, 5-5—5-6, 6-11, D-2, E-5—E-7
ARQ (&A), 5-5
Connection rate, 3-5, 4-13—4-16, App. A
Connectors
requirements, 2-2
physical assembly, 2-2
RS-232 interface definitions, B-2, B-3
CRC, cyclic redundancy checking, A-5
CTS, 4-7, 4-8, 4-9, B-5
Customer service, USRobotics, x, D-5

D

Data compression (&K), 1-1, 4-12, A-6—A-7
.ARC files, A-9
binary files, A-8, A-9
MNP5, disabling, 4-12, A-9, B-18
Data format, 3-4—3-5
Data rate, 3-5, 4-13—4-16
300 and 110 bps calls, 4-16
asymmetrical, 1-1, H-1
fixed/variable, 4-15
forcing 300-bps back channel (S15), B-15
link negotiation, 3-5, 4-15, A-1—A-5
online fallback, 3-6, A-1, A-4, A-5, E-5, H-3
standards compatibility, 1-4—1-5, H-1
Data rate select (&B, &N), 4-1—4-16
Data Set Ready (DSR, &S), 4-16
Data Terminal Ready (DTR, DIP switch 1, &D), 4-17, B-6
DCE, 4-1, G-4
Defaults
command summary, App. C
NRAM/factory, B-10
NRAM S-Register options, B-11
setting, 5-1
Department of Communication (DOC), xi, xiii, 6-9
Detection phase, V.42, A-6
Diagnostics
call/link (ATI6), 8-3
testing, see *Testing*
Dial, auto
at a glance, 3-5
commands, functions, 6-3—6-7
stored phone number, 6-7—6-9
Dial test (S16), F-9
Dialing type
adaptive, 5-8, 6-4
pulse/tone, 6-4
Digital signals, G-5
DIP switches, 2-6, B-6—B-8
auto answer, 6-11—6-12
CD override, 4-17, D-2
command set recognition, D-1
disconnect/hang up, 6-10—6-11
DTR override, 4-17, D-1
escape code operations, 6-9—6-10
load options, 5-2—5-3
local echo, 2-8, 5-9
result code display (quiet mode), 2-9, 5-5, D-1
Result codes verbal/numeric, 5-4, D-1
RS-232 DTE interface, 7-2, B-2
Disconnecting (H, +++), 6-9—6-11
DOC, xi, xiii, 6-9
DSR (&S), 4-16
DTE, defined, 4-1, G-5
speed select (&B), 3-2, 3-3, 3-4, 4-14

DTR, Data Terminal Ready, 4-17, D-1
dropping to force disconnect, 6-10
Dual Standard Modem, ii, 3-1, 4-2, 5-6, 6-1, 7-4, A-5
Dumb mode (DIP switch 8), 2-9, B-7
Duplex, Half/Full, 5-9, G-5

E

Echo, local 2-8, 5-9
ENQ character, HP installations, 4-6, 4-11, E-11
Error control, see ARQ
Error control, using, 1-1, 4-5, 6-2
ERROR message, 5-7, 5-8
Escape code (+++), 6-9
changing ASCII definition (S2), B-12
to terminate testing, App. F
Extended result code set, 5-5—5-6, E-5
Extensions
calling another, E-8
transferring calls to (!), 6-6

F

Factory settings, 2-6, 5-2—5-3, App. B
Fallback, data rate
link negotiation, 3-5, 4-15, A-1—A-5
online, 3-6, A-1, A-4, A-5, E-5, H-3
disabling (S15), B-15
FCC certification, xi, H-8
File transfer
compressed files, 4-3, 4-12, A-9
protocols, 4-4, A-8
Fixed/variable data rates, 4-15
Flow control, 1-1, 3-2, 4-6—4-11, A-7
Front Panel indicators, 2-4, B-4
Full duplex, 5-9, G-6

G

Guard tone (&G), 6-13

H

Half duplex, 5-9, G-6
Handshaking, 6-12, App. A
Hanging up (H, +++), 6-9—6-11
HDLC, 7-1, G-6
Hardware switches, see *DIP switches*
Help screens, list under *Commands*
Hewlett Packard installations, 4-6, 4-11, E-11
HST (High Speed Technology), 3-1, 4-2—4-3, 6-1, 7-4, 8-3, A-1

I

Inactivity timeout (S19), 1-3, B-16
Indicator lights, 2-4, B-4—B-5, F-1
Inquiry (I) options, 8-1—8-5
Installation, 2-4—2-6
International calls, 6-12—6-13
B0, 6-12
&G, 6-13
&P, 6-13
V.21 (S.27), 1-4, B-17
V.23, 1-4, B-19

K

Kermit protocol, 4-4, A-8

L

LAPM, 1-1, 4-5, A-6
Leased line installation, operations (&L), E-8—E-10
LED displays, 2-4, B-4—B-5, F-1
Line feed, ASCII definition (S4), B-12
Link diagnostics display (ATI6), 8-3
Link interface
operations, 4-13—4-16, A-2, A-3, A-5,
speed select (&N), 4-15
Link rate negotiation, 3-5
Load number, DOC, xiii
Local echo, 2-8, 5-9
Loopback tests, App. F
Low speed calls, 4-3, 4-16

M

Manual, how to use, ii—iii
Memory, modem
nonvolatile random access (NVRAM), 5-1—5-3, B-8—B-9
random access (RAM), 8-1, G-9
read only (ROM), 8-1, G-9
MNP, Microcom Networking Protocol,
error control, 1-1, 4-5, A-4, G-7
data compression, A-6—A-5, 4-12, A-6—A-7
disabling, 4-12, A-9, B-18
Modem
defaults, App. B-2, App. C
defined, G-6
installation, 2-2—2-6
problems and solutions, App. D
repair, x, D-4
testing, App. F

Modulation
compatibility, 1-4—1-5, 6-1, 7-3, H-1
high speed, 4-2—4-3, A-1—A-4, H-1

N

NO ANSWER result, 5-5—5-6
NO CARRIER result, 5-5—5-6, 6-11, E-6—E-7
NO DIAL TONE result, 5-5—5-6
Nonvolatile random access memory (NVRAM)
configuring, 5-1—5-3, B-8—B-9
defined, 5-1, G-8
DIP switch 10, B-7
options, B-9—B-11
resetting to (Z), 5-3
storing phone numbers in (&Zn=s), 5-3
writing to (&W, &Zn=s), 5-1, 5-3

O

OK message, 2-8, 5-5—5-6
110-bps calls, 4-16
Online local echo, 2-8, 5-9
Online fallback, 3-6, A-1, A-4, A-5, E-5, H-3
Operations
auto answer, 6-11—6-12
auto dial, 6-3—6-9
error control, 4-5, 6-2
flow control, 3-2, 4-6—4-11, A-7
high speed, 4-2—4-3, A-1—A-4
link negotiation, 3-5, 4-15
synchronous, Chapter 7, B-3
Originate mode, 6-7, E-2—E-4, E-9
Overseas calls, 6-12—6-13, B-17, B-19

P

Parity, 3-5, 6-2
defined, G-8
Party lines, xi
Pause during dial (,), 6-4
Percent commands, 4-18
Phone company, connecting to, xi
Phone line interface, 2-5—2-6, H-2
dedicated or short line (&L), E-8
Phone number storage (&Zn=s), 5-3
inquiry, 8-6
Phone jacks
on Courier, 2-5
RJ11C, 2-1
Phone number storage (&Zn=s), 5-3
Placing a call, 3-5, 6-3—6-7
Pound sign, dialing (#), 6-4
Problems and solutions, App. D
Programming rate switching, E-5—E-7
Protocol
defined, G-9
file transfer (Kermit, Xmodem, etc.), 4-4, A-8
synchronous, 7-1
Pulse dialing, 6-4

Q

Quiet mode, 5-4, D-2

R

Rack Controller Unit Access (%R), 4-18
Radio/television interference, xii
RAM, random access memory, 8-1, G-9
Rate select commands
DTE rate (&B), 4-14
link rate (&N), 4-15
Received data flow control (&I, &R), 4-9—4-11
Redial/re-execute
continuous (A>), 6-9
one time (A/), 6-8
Remote digital loopback, F-5—F-7
Remote echo, 5-9
Repeat mode commands (>, A>), 6-8—6-9
Request to send (RTS), 4-9, B-5
Requirements, operating, 2-1—2-3, 3-1—3-2
Reset to NRAM defaults (Z), 5-3
Result code sets, 5-6—5-7
Retrain sequence, 3-6, 8-5, A-3, A-5, B-4, B-19
Retransmission, 4-1,
RING result code, 5-5—5-6
RINGING result code, 5-5—5-6
RJ11C jack, 2-1
RMA (Return Materials Authorization) number, x, D-5
ROM, read only memory, 8-1, G-9
RS-232 interface, 2-2, B-2, B-3
CD (DIP switch 6), B-7
connectors, B-2, B-3
CTS (&H), 4-8, B-5
DSR (&S), 4-16, D-1
DTR (DIP switch 1), 7-4

Quad switch, B-8, D-2
RTS (&R), 4-9, B-5
synchronous calls, 7-2, 7-4, B-3

S

SDLC, 7-1
Serial transmission, G-9
Settings
changing, 4-2, 5-1
default, 4-2, 5-1, B-9—B-11
Smart mode (DIP switch 8), B-7
Speaker (audio monitor), 5-10
Specifications, App. H
Speed recognition, 4-12, 6-1, App. E-2
Speed select
DTE rate (&B), 3-2—3-4, 4-14
link rate (&N), 4-15
S-registers, 5-12, 8-9, B-12—B-20
inquiries, 8-6
Standards
Courier compatibility with, 1-4—1-5, 6-1, H-1—H-2
RS-232, 2-2, B-2, B-3
Star button, dialing (*), 6-4
Start/Stop bits, 3-5, 6-2
Store phone number (&Zn=s), 5-3
inquiry, 8-6
Switches, 2-3, 2-6, B-6
Synchronous operations, Chapter 7
RS-232 requirements, 7-2, B-3

T

Technical Specifications, App. H
Technical Support, USRobotics, x, D-5
Telephone company, connecting to, xi
Television/radio interference, xii
Terminal (DTE) interface speed select (&B), 3-2—3-5, 4-14
Terminal Mode, 2-7, G-10
Hewlett Packard, 4-11, E-11
Terminology, 4-1, App. G
Test pattern, F-9
Testing, App. F
installation, 2-7—2-9
Throughput, 4-3—4-4, 4-12, A-5—A-9
Touch-tones
dialing, 6-4
timing, spacing (S11), B-13
recognition (%T), 4-18
Transmission rate, 4-4, 4-13—4-15, 6-1
DTE interface (&B), 3-2—3-4, 4-14
link interface (&N), 4-15
Transmit data flow control (&H), 3-2—3-4,4-7—4-8
Trellis coded modulation, 1-2, H-1

U

Unattended operation, see Auto Answer
United Kingdom requirements
CCITT answer sequence (B), 6-12
Guard tone enabled (&G), 6-13
Pulse dial make/break ratio (&P), 6-13

V

V.xx, CCITT compatibility, Glossary
V.21, S27, 1-4, B-17, H-2
V.22, 1-4, B-19, H-2
V.23, 1-4, H-2
V.25, 1-4, H-2
V.32 *bis*, 1-4, 4-2—4-3, H-2
V.42 error control, 1-4, 4-5, A-6, H-2
V.42 *bis* data compression, 1-4, 4-12, A-6
V.54, 1-4, F-1
Variable/fixed data rates
DTE interface (&B), 4-14
link interface (&N), 4-15
Voice/data communications
configuring for, 2-3
using both, E-2—E-4

W

Warranty information, x
Word length, 3-5, 6-2, H-3

X

Xmodem-type protocols, 4-4, A-8

Y

Ymodem, 4-4, A-8

Z

Zmodem, 4-4, A-8

NOTES

NOTES

NOTES

NOTES

NOTES

NOTES

U.S. Robotics®

8100 North McCormick Blvd.
Skokie, Illinois 60076-2920
Sales 800-DIAL-USR
Service: 800-982-5151
FAX (708) 982-5235

1.015.422 Rev. A